AGRICULTURAL ENGINEERING

MAY · 1945

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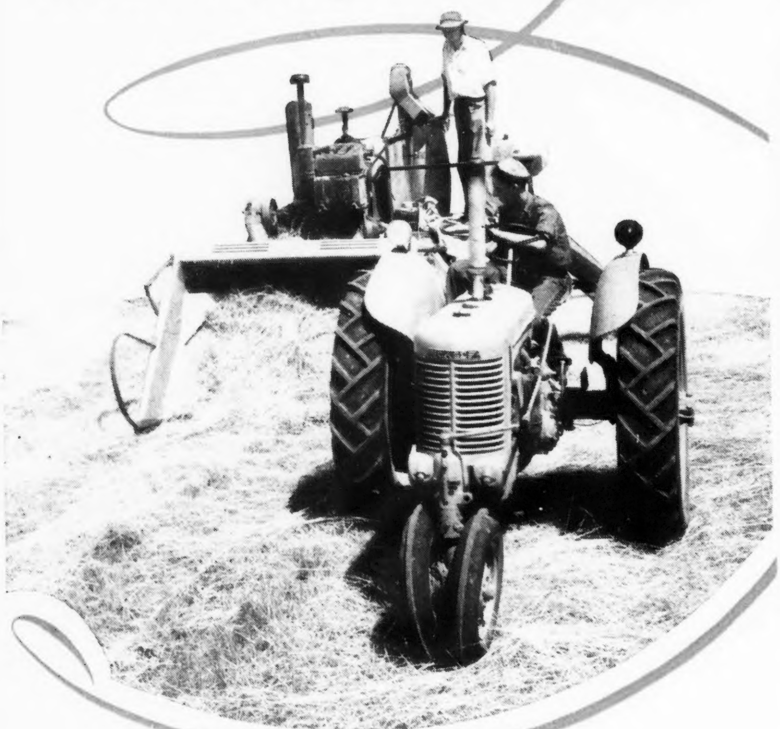

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TYPICAL ANALYSES OF ALLOY CAST IRON IMPLEMENT AND TRACTOR PARTS

Applications	*Total Carbon*	*Silicon*	*Nickel*	*Chromium*	*Molyb-denum*	*Brinell Hardness*	*Tensile Strength (lbs./sq. in.)*	*Desirable Characteristics*
Pulleys and Frames	3.40-3.60	2.00-2.50	.25- .50 .50- .80	....	....	160-180	35,000 min.	Improved Machinability Resistance to Impact
Clutch Plunger Rods	3.20-3.40	1.80-2.10	.50-1.00 .60-1.00	.... .25- .40	....	160-180	35,000 min.	Resistance to Wear Improved Machinability
Clutch Plates	3.00-3.25	1.60-2.00	.50- .80 .60- .90	.20- .35		160-200	35,000 min.	Resistance to Wear Improved Machinability
Brake Drums	3.00-3.25	1.60-2.00	1.00-1.50 1.25-1.75	.40- .60 .35- .60	.25- .45	175-225	35 to 50,000 min.	Resistance to Wear Improved Machinability
Gears and Sprockets	2.75-3.20	1.40-1.80	.40- .65 .75-1.25 1.00-1.50 1.50-2.00 2.00-2.50	.15- .30 .30- .60 .50- .80	.... .30- .60	175-275	35 to 60,000 min.	Resistance to Wear Heat Treat Hardenability Improved Machinability
Cylinder Heads	3.00-3.25	1.40-1.80	.30- .60 .50- .80 .60-1.10	.15- .30 .25- .50 .15- .30	....	170-200	35 to 40,000 min.	Improved Machinability Resistance to Growth
Motor Blocks	3.00-3.25	1.40-1.80	.30- .60 .45- .80	.15- .30 .25- .40	....	170-200	35 to 40,000 min.	Improved Machinability Resistance to Growth
Exhaust Manifolds	3.00-3.25	1.40-1.80	.30- .60 .75-1.25	.15- .30	....	160-190	35 to 40,000 min.	Resistance to Growth
Cylinder Sleeves and Liners	2.90-3.25	1.30-1.70	.50-1.00 1.25-1.75 1.50-2.00	.30- .60 .... .50- .80	.... .30- .60	190-260 As Cast 350-500 As Heat Treated	40 to 60,000 min. 75,000 min.	Resistance to Wear Heat Treat Hardenability Improved Machinability Resistance to Growth
Valve Inserts	2.90-3.25	1.40-1.80	.50- .80 .50- .80	.40- .60 .30- .50	.... .30- .50	As Cast) 190-300)	40 to 50,000 min.	Resistance to Wear Heat Treat Hardenability Improved Machinability Resistance to Growth Resistance to Impact
Crankshafts	2.60-2.90	1.70-2.00	1.00-1.50 1.50-2.00 1.75-2.25	....	.70-1.00 .30- .60 .40- .80	250-290 As Cast 300-420 As Heat Treated	65,000 min. 80,000 min.	Resistance to Wear Heat Treat Hardenability Improved Machinability Resistance to Impact
Seed Grinding Burrs	2.75-3.25	1.00-1.50	4.50-5.25	1.50-2.00	....	*600-750		Resistance to Wear Resistance to Impact
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*Chill cast or sand cast white.

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AGRICULTURAL ENGINEERING

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CONTENTS FOR MAY, 1945

Vol. 26, No. 5

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EDITORIAL

Indictment of the Plow

DESPITE the flurry caused by the Faulkner book, the plow as a tillage implement remains very much with us. From that flurry has come a clearer understanding of the function of the plow, how it may be used to better purpose, and more definite delimitation of the places where it need not be used at all. We hope for some such happy consequences to the criticism of "plow terraces" by Marion W. Clark in his article appearing in this issue.

We prefer to put the quotation marks around that phrase "plow terraces" because we believe no terrace should show such tell-tale signs of the way it was built. Certainly we cannot quarrel with Mr. Clark in his condemnation of any terrace which conforms to a mode of construction rather than to its functional requirements. Yet we shrink from putting a curse on the "plow terrace" as such.

As Mr. Clark says, promotion of terracing with plows is not promotion of plow sales, except in the remote sense that plows worn out a little faster may be replaced a little sooner. We have every reason to believe that such promotion by farm implement companies has been a sincere effort to help the cause of soil conservation. We believe they will be quick to correct the slipshod tendencies he describes.

It all boils down to the fact that terraces are being built without adequate engineering supervision. With such supervision and sound standards of construction, the choice of equipment will pretty well take care of itself. Even if the rational place for the plow in terracing is smaller than its protagonists have believed, it would be a great loss if the psychological advantage of the plow methods were to be wiped out.

As professional men, agricultural engineers are not too good at "tooting their own horns." It may well be proper and constructive for the builders, not only of plows but of all terracing equipment, to feature in their promotion the indispensability of engineering guidance.

Why So Many Jobs?

AFTER seeing the goal for postwar employment gradually bid up from 55 to 57 to 59 and finally 60 million jobs, we got to wondering whether this nicely rounded figure takes into account two things in which we are deeply interested—education and agriculture. In the figures which follow we project to the year 1950 by increasing 1940 population values by a little over six per cent.

A school man tells that in 1940 nearly 24 per cent of the 18-to-21 age group were in school or college, and of the 21-to-24 bracket, five per cent. With no increase in education except in proportion to population these groups will total about 2.3 million in 1950. In the 18-to-65 plans for full employment all these students seem to be counted in. It would give great impetus to ignorance and the movements which thrive on ignorance, but it would liquidate all the colleges and universities and set all the professors to looking for other jobs.

Whether the 60-million-jobbers are aware of agriculture is not clear. But if in 1950 we have 6.1 million farms and each has a farmer and a farmwife, it means 12.2 million people not available for jobs. By that time the total population in the 18-to-65 range will be about 87.6 million, almost evenly divided between men and women. If we leave the students in school and the farm folks on the farm, there will be 73.1 million men and women for 60 million jobs.

Assuming that there are no unemployables in the male half, and that no one is permitted to retire under the age of 65, there will be men enough for only about 36.5 million jobs. That leaves some 23.5 million jobs to be filled by women, or 64 per cent of all non-student, non-farm women from 18 to 65. Perhaps as engineers we have no right to wonder what that would do to the home and the family, but as American citizens we can hardly feel happy at the prospect.

Deep in the purpose of any engineer is the idea of lightening the burdens of all people, and of lifting the work load entirely from the shoulders of the young, the aged, and the infirm. In addition, agricultural engineers are greatly concerned with higher education. The deplorably low average education of the American farmer is a major obstacle to the adoption of engineered methods. We would suggest strengthening, not weakening, the family; increasing its income not by employing more of its members, but by increasing the production of those employed; fortifying the national economy by national income based on high production and consumption.

The Two-Family Farm

DESPITE the determined trend in recent years to create tractors, combines and other mechanized units in smaller and smaller, or at least cheaper and cheaper, models to fit smaller and poorer acreages, it remains obviously an economic fact that the man who turns one furrow does not deserve and can hardly hope to secure the same earnings as if he turned three. In a free economy this will be true whether that man happens to be a farm operator or a hired man.

Machinery units which use man power efficiently are too large, or rather too costly, for the majority of American farms. Only on acreages sufficient to permit machinery that will increase production per man can we hope for any substantial increase in annual earnings per family. To attain standards of income comparable to those taken for granted in the city, the families on these farms must increase both their gross incomes and their percentage of margin within that gross.

A promising and fairly well-demonstrated expedient is that of consolidating the acreage and the operation of two rather undersized farms. Immediately the optimum capacity of many, not all, machines is doubled with similar increase in productivity per man-hour or man-year. Considered as labor savings, the gain appears either in a reduction of hired help, or is reflected into more thorough tillage and better attention to livestock.

Such doubling up of farms often is accomplished by purchase or rental of one farm by the operator of the other. Less frequently seen, but worthy of increasing consideration is consolidation of operation by two families in cooperation. Current examples seem more usually to consist of such family combinations as brother and brother or father and son. The advantage *(Continued on page 216)*

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A Terracing Challenge to Engineers

By Marion W. Clark
MEMBER A.S.A.E.

THE subject matter of this paper will be limited to terracing in Missouri because of my responsibilities here and because of my background and the experience I have gained over Missouri and southwestern Iowa. This paper will present views contradictory to those held by some folks engaged in soil conservation work. I have no desire to take in too much territory or to make any statements of a propaganda nature, or that are not backed by facts that apply to the many and varied conditions found in Missouri. I might add further, that many of the conditions found in Missouri are duplicated to a marked degree in other areas of surrounding states of the Middle West.

Missouri lies in such a latitude, is topographically rolling to rough, and is subject to such torrential rains that soil erosion on cultivated slopes is very serious. The central and northern parts of the state, particularly the northwest, is covered with a deep fertile soil that produces well. A high per cent of such land is kept in grain rotations, and to keep any sizable proportion of it under sod cover is uncommon.

Returns from farm land are generally high, and erosion is well controlled on most Missouri uplands if terraced and farmed on the basis of suitable crop rotations and soil treatments. This is aside from the permanent pasture used for grazing livestock, which in general is pretty well protected from sheet water.

There are many people who do not consider a terrace needed or desirable; also there are those who believe soil treatments are a waste of time and money. As could be expected in almost any state, there is too large a number of farmers who do not have a firm belief in a systematic rotation of crops. From limited observation in other states, we would place the number of such non-believers in terraces higher here than in the southern and southeastern states. One reason for this may be that many Missouri farmers have not been driven to this added protective measure to such an extent as farmers in the other areas, and as a result have not by experience learned as much of the value of terraces.

Observation would also lead one to believe that Missouri farmers are doing more terracing than is being done in the states north, northeast or northwest of Missouri. These states do not have as much open winter and torrential rains with long, hot summers to burn out organic matter, and perhaps do not see quite the need for the added terrace protection that Missouri is recognizing.

Missouri has what is coming to be known as a balanced system of farming. This program combines a well-planned *water management system* and the crop rotation best suited to the land with the farm enterprise in such a way as to give maximum soil erosion control with maximum financial returns, and, as a result, the farm improvements that go with the higher standards of living.

Whole farms are protected with a good water management system, including all tillable land terraced with *good standard terraces* and provided with constructed grass outlets and all the Missouri soil-saving dams that are necessary to let water from these terrace outlets into well-stabilized branches and natural drainageways. In the water management system put into effect on the farm are deep, well-fenced farm ponds carefully located and equipped with a concrete or metal tank below the pond to provide clear cool water for livestock at all times. A sanitation system of livestock management is also a definite part of the program on all balanced farms.

Lespedeza and small grain rotations, while needing more protection from erosion than permanent grasses, have become a major factor in giving materially higher incomes to farmers and in reducing the acreage of clean-tilled crops at the same time.

Considering the important over-all or balanced approach and the practical *high standards* of work required, Missouri is credited with an outstanding program of good farming and soil conservation. In fact, the state is often credited with being the number one state in supporting an erosion control program which gets to the cause and gives results.

If this is correct, let us look closer at some of the things that have placed Missouri close to or at the top of the list in real soil conservation accomplishments. What has allowed her to make rapid but steady and unchanging progress for the past decade and longer?

A careful analysis of all the "whys" would perhaps be revealing, but space here will permit mention only of those activities pertaining to the engineering or structural phases of the over-all state college and extension program, as follows:

1 Terraces, gully control structures and farm ponds are treated as only one part of the broad program, and these are coordinated with the teachings of the other college departments to get consistent, effective operation in the field.

2 No system of crop rotation, other than permanent grass well controlled for grazing, gives adequate protection from sheet erosion on the sloping uplands. Neither does contour cultivation alone, on either row crops or small grain crops.

3 Terrace structures, crop rotations and soil treatments are not *competitive* but *complementary* measures.

4 A terrace does not add fertility in any sense but aids in conserving fertility and moisture.

5 Economical and effective vegetative terrace outlets and overfall structures have been developed, making it possible to place a whole farm

This picture shows a constructed terrace outlet on the Will Bowling Farm, near Columbia, Mo., with the Missouri soil-saving dam to let the water from the grass outlet into a stabilized natural drain. This outlet is on an approximately 8 per cent slope and carries drainage from 20 acres of terraced land. Terraces were built by contract and are good Missouri standard terraces

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MARION W. CLARK is associate professor in charge of agricultural engineering extension, University of Missouri.

under a water management system without undue expense in first cost of maintenance.

6 Financial returns received as years pass from such a system of balanced farming accelerate the results from individual practices and sell the program to observing farmers.

7 With a practical design and nothing but a high standard of work, a minimum of failures can be expected. This is necessary for any program to attain the highest success and maintain itself. This is probably the most important point of the seven mentioned dealing with any mechanical work in soil and water conservation.

At this point I want to point out what I believe to be the most dangerous and damaging practice to come into soil and water conservation work in recent years. I refer to the "*plow* terrace" and the propaganda being put forth to promote it. It is dangerous because the attempts to popularize it involve a low standard to secure quantity of work and almost total neglect of quality.

I want to stress again that I do not wish to take in too much territory and speak for conditions in other states, but not more than one-half of one per cent of the plow-built terraces in Missouri are anywhere near the standards we have set up for *minimum specifications* of good terraces. Our standard is not an arbitrary one, but one built on years of use and experimentation in Missouri. If the propaganda for "plow terraces" specified that a standard terrace be built and a blade or other terracing equipment be used, when failure to build a good terrace with the plow was evident, thus minimizing the *easy plow idea,* there would be no such serious cause for alarm. The one biggest problem in the terracing program is to get farmers to stay with a terrace until it is completed, but now we are confronted with the idea, so old that it sounds new, that a "plow terrace" will do the job without any definite specifications being required or even mentioned. The whole "plow terrace" program pushed by some plow manufacturers and others is, from our study, observation, and firm conviction, doing infinitely more damage to any sound, long-time program of real soil and water conservation than any other one thing that has been done for years.

We would all be greatly pleased if we could *wish* a terrace or *pass an act* to make even an imaginary line carry water at non-scouring velocity. Perhaps as workable and an even better idea would be to control torrential rainfall. A fraction of a specification terrace will carry all the water from a rain that causes little or no runoff. Over 95 per cent of soil erosion damage is done not by the average rain but by a very few of the most intensive rains, often only one or two rains in a crop season. Sometimes not even one seriously damaging rain may occur in one year's time in a given area.

This leads some folks to think they have a creditable terrace when it falls short of being a permanent improvement and will damage instead of protect the investment in soil building. We consider the terrace system as the foundation of the whole soil-building program. Why court failure of that entire program by putting in the kind of foundation that has failed in the past, that is failing today, and that at present low standards backed by propaganda will always fail.

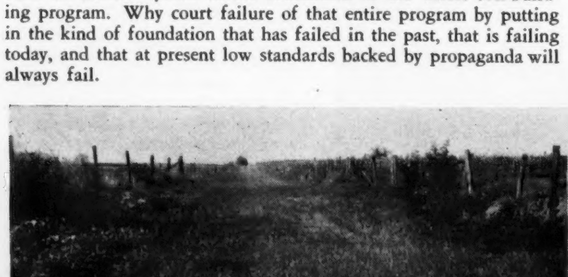
Since terraces have been in use in Missouri we have had some of them built with a plow and nothing more. A very small percentage of these terraces have proven satisfactory, some few of them approaching standards that can be depended upon to be more useful than detrimental. The better of these terraces are usually the result of several years of plowing and have suffered breakovers from heavy rains during the time lapse in building. Occasionally, however, where there is plenty of moisture in the ground to pack well, where the slope is gentle and rubber-tired tractors are used, and where heavy vegetation is removed and enough time and persistence is used, a terrace that will not fall far short of the minimum *terrace* specifications can be built with only the ordinary breaking plow equipment. If these favorable conditions do not prevail at the place and time the terrace is started, an endless amount of work, with only the plow, does not result in a creditable terrace regardless of plow technique used. Only rain, lapse of time or other equipment can finish the job. We know that if one is not accustomed to definite standards—and the average farmer starting his terracing is not—there is a tendency to think that almost any kind of terrace is too high and too wide. The small terrace will be popular with the farmer, at least until he gets a few hard rains and a bunch of gullies or extensive repairing operations confronting him.

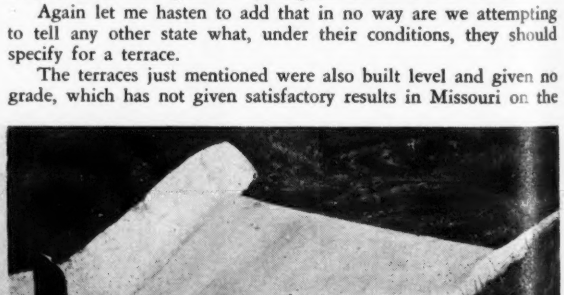
Because now as in earlier years such a very small per cent of plow-built terraces approach anywhere near to a standard terrace, I reiterate that the effects on the terrace program are dangerously negative. We have never encouraged farmers to use *nothing* but a plow to build a terrace. We have helped farmers build standard terraces—or in too many cases just tried to—with old and new plow technique, and checked many others, but we haven't encouraged such efforts for farmers in general. Usually we have completed such terraces with regular terracing equipment in order to attain the recommended standard. We do not make a major point of recommending a blade terrace, or a whirlwind terrace, or a terrace built with an elevating grader, etc., let alone mentioning a plow terrace. What we do emphasize is the terrace and not the equipment. With even good terrace-building equipment available, this is the only safe recommendation.

In a controversial discussion about three years ago regarding plow-terrace propaganda, we were reminded of that much-advertised plow terrace contest in Mills County, Iowa. The records showed that this particular contest was held on deep fertile soil with a very gentle to rolling slope. The cross sections of the terraces built the year before were examined in connection with the discussion, and with the best of builders, the best of plow equipment, and the best of soil conditions and slope, not one terrace, including that built by the winner of the contest, came up to the minimum Missouri specifications for a standard terrace, regardless of the tractor equipment used or time spent in building the terrace at the contest.

Again let me hasten to add that in no way are we attempting to tell any other state what, under their conditions, they should specify for a terrace.

The terraces just mentioned were also built level and given no grade, which has not given satisfactory results in Missouri on the





(Left) A constructed or leveled grass outlet as a part of a water-management system. This outlet is fenced. Notice the hay stack in the background which was cut from the grass outlet. This shows the production value of such a structure while it is carrying runoff water from the field protected by good standard terraces • (Right) One of two Missouri soil-saving dams used on the 160-acre Campbell farm in Boone County, Mo. The farm is completely terraced. All water falling on this farm flows with velocity control to this main outlet where it is let down approximately 8 ft by the use of this structure. These two pictures show typical applications of engineering to save soil.

same general type of soil found in the northwestern part of the state. We may think we are getting by with it for a few years, and a few people will try it each year, but it has never proven to be sound for Missouri. After a few years of use we find farmers trying either to cut grade in the terraces or letting them drain themselves by breaking over and cutting ditches down the field.

Now why should some of our good farm implement companies join the propaganda wagon in promoting this "plow terrace" thing? Frankly, I don't know! I seriously doubt if one extra plow will be sold for the sole purpose of building terraces. One certainly can't build terraces to our *specifications* or for contract with a plow and expect to make a living in Missouri. We doubt if they can anywhere in the United States. I am convinced that some of, if not all, the implement companies are sincere and unselfish in their efforts to do what they think is helping the over-all problem, without realizing they are adding greatly to what will, without a sharp change in direction, be the eventual collapse of a terracing program.

Why should a government agency so strongly support a practice which we maintain, if carried out as publicized, would cause the collapse of our terracing program? Again I do not know. However, it is true that at least some immediate popularity could be gained by suddenly finding a means to solve farmers' terracing problems so easily. One would almost conclude from some of the claims that the plow must be kept tied up so it won't break loose and terrace a farm according this new short cut to success. A long-winged plow was built and sold in Texas twenty years ago. It was built with a special moldboard for terracing. I haven't heard of one being used for ten years. We have one in the attic of the agricultural engineering building at the University of Missouri and got it down last year to plow cross berms in a constructed seeded terrace outlet on one of the University farms, but not to build terraces. Good equipment for the job and lots of hard work either done by the farmer or paid for by him is the shortest cut to success many of us know.

Plow terraces and all other kinds of carelessly built terraces set Missouri back seriously in its program several years ago. In fact, the substandard terrace was responsible for such a severe setback in this work that, according to our records, such terraces caused more damage than they did good. Therefore, many good farmers and most of our college of agriculture decided it was a mistake to encourage their use. To a few good research and extension agricultural engineers, who know what a good terrace is and what a poor one will do to the program, goes the credit for putting terracing on the unquestioned—in fact, the "must"—list again after years of hard, accurate work. Some states have passed through this careless stage, and many others are now passing through it or have not yet recovered from it, and will not recover from the setback for at least a generation or longer.

It is not popular, I realize, to disagree with the many high federal and some state officials who are falling in line with *poor make-believe cures for soil erosion.* It is much easier to drift along with the current and not have criticism directed at you from those who seek to justify their stand, or to be the target of self-seeking politicians. Of course, there are those who actually do not know any better, because they have been sold on some good-sounding cure-alls.

In Missouri the complete farming plan is figured out with the farmer on the farm, and a complete water management plan is used to give proper support to the whole farm plan of operation. A balanced farming plan includes livestock management, crop rotations and soil treatments with terraces and outlets, soil-saving dams, etc., built to a plan for that farm. A safe standard is set forth in University of Missouri Station Bulletin No. 400 regardless of methods used. The standards of work and workmanship are what is stressed and no low standards are encouraged.

With a lot of hard, sincere effort guided by nothing but sound principles and definite standards on the part of the supervisors, with proper support given the college of agriculture, county extension agents, and other agencies or groups interested, each state can keep moving forward indefinitely without costly setbacks in time and financial returns or lost confidence on the part of the farmer and his neighbors. These farmers are the ones who in the last analysis will have to go ahead and pay for the actual soil-saving work, and they must stay sold on it to keep progressing.

A concluding thought is that, unless federal and state agencies stick to basic facts and stop distorting or coloring such facts, the public will have even less confidence and the *better parts* of water management programs will be severely penalized.

A New Concept in Farm Lighting

By L. C. Porter
FELLOW A.S.A.E.

IN ORDER to provide a method of roughly estimating the number of lamps required by dairies and poutries, bulb counts were made on three carefully selected typical poultry farms and on three corresponding dairy farms. Another count was made on a large poultry farm to see how it compared with average ones, and to determine what wattage lamps were in use and for what purposes.

Since the farms selected are typical and modern, the data from them can be applied with reasonable accuracy to determine what the lamp requirements are likely to be on other poultry and dairy farms. To do that a new concept has been used by figuring out the lamp wattage per bird for the poultry farm, and per cow for the dairy. As might be expected, the watts per bird for a 5,000-bird poultry farm are somewhat less than for a 1,700-bird farm—1.71 for the former and 2.3 for the latter. Probably a somewhat similar ratio would hold for a large dairy versus a 25-cow dairy.

The figures obtained in the counts are as follows:

Farm	Type	Number of Lamps In the home	Number of Lamps On the farm	Total Lamps	Total Lamp watts
1	Dairy 25 cows	36	50	86	4825
2	Dairy 17 cows	27	21	48	3430
3	Dairy 25 cows	28	23	51	2580
4	Poultry 1800 hens	42	48	90	3437
5	Poultry 1600 hens	26	27	53	3350
6	Poultry 1700 hens	50	32	82	4710
Average		35	34	68	3722

Farms 1, 2, 3: average watts per cow, 161.7
Farms 4, 5, 6: average watts per hen, 2.3
Average lamp wattage, 54.7

NUMBER AND TYPE OF LAMPS USED IN A TYPICAL 5,000-BIRD POULTRY FARM

	15-w	40-w	60-w	100-w	50-w 100-w 150-w	S-4 Sun lp.	15-w Germ.	30-w Germ.	20-w F.	40-w Lumi-line
Workshop			9	1						
Garage			2							
House		18	3	10	2				2	1
Poultry	79	20	29	1		14	2	2		
Total lamps	79	38	43	12	2	14	2	2	2	1
Total watts	1185	1520	2580	1200	200	1680	30	60	40	40

Total bulbs 195
Total lamp watts 8535
Average bulb wattage 43.8
Total bulbs for lighting only.. 177
Average bulb wattage for lighting only 38.2
Electric bill for 1 year $225.75
Lamp watts per bird 1.71
Electric bill per bird per year .... $ 0.045

Attention is called to the fact that none of the auxiliary lighting lamps, such as refrigerator lamps, electric range lamps, sewing machine lamps, radio panel lamps, vacuum cleaner lamps, flashlights, etc., was included in any of the above data. When such lamps are counted, the total bulbs per small farm can easily be doubled.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

LAWRENCE C. PORTER is illuminating engineer, Nela Park Engineering Division, General Electric Co., and chairman, A.S.A.E. Committee on Electric Light in Farm Production.

Flax Straw—a Source of Income and How to Harvest

By S. C. Heth
MEMBER A.S.A.E.

FLAX is one of the most stable-priced crops. In the eight-year period from 1934 to 1941, inclusive, the low-season average price per bushel of flax seed was $1.42, and the high was $1.90 according to USDA agricultural statistics. The importance of this crop is attested by the USDA valuation of the flax seed crop in 1941 as being $54,311,000.00 for the continental United States.

Developments by state agricultural experiment stations, of varieties resistant to wilt, rust, and pasma, give the grower in all principal U. S. flax-seed-producing areas, an excellent choice of seed to suit his soil and climatic conditions.

The use of flax straw to augment the flax-seed grower's income is a fairly recent development. In recent years there has been a tremendous increase in the market for flax straw. Insulation material plants, tow mills, paper mills, corrugated board manufacturers have been established in the major flax-seed-production areas of the United States. It is reasonable to anticipate an unprecedented increase in the demand for flax tow for automobile-body insulation etc., etc., in the postwar period.

At present, there are about 10 plants in Minnesota with an approximate capacity of 500,000 tons of straw, whereas 5 years ago, to the best of my knowledge, there was only one plant, with a capacity of 35,000 tons annually. The situation in Minnesota alone is indicative of the expanding market for flax straw.

Of particular interest is the fact that flax straw, a potential source of farmer income, has been a troublesome aftermath of the seed-crop harvest. It does not rot readily and has always been a source of difficulty in plowing and cultivating due to the propensity of its tough long-lasting fibers to pick up and drag on implements. Flax straw from the thresher was invariably burned, and, after two or three attempts to plow under combined flax straw, farmers usually went to the expense of raking and burning it.

The market price for flax straw from seed flax is dependent to a substantial degree upon the length of unbroken fiber. Of course the length of straw in the plant is the basic factor involved; however, the harvesting process has much to do with fiber length. Generally speaking, the price for the past several years for flax straw, baled at the mill, has been as follows:

Threshed with a toothed cylinder	$ 6.50	per ton
Threshed with rub bar cylinder	8.00	" "
Threshed with rubber-roll-equipped machine	10.00	" "

The straw yield per acre of seed flax runs from a few hundred to over 5,000 lb per acre. The average tow yield of 25 varieties in test plots in the Northwest was 715 lb per acre. An ordinary yield of flax will produce ½ to 1 ton of straw per acre. Considering that the grower is usually put to considerable trouble and expense to burn off this straw, if he doesn't bale and sell it, the total value of the straw to the grower is greater than indicated by the sales price.

An investigation of the flax straw situation on farms in the Red River Valley area of North Dakota and Minnesota, over a period of three years, revealed that the farmers received approximately $2.50 per ton for flax straw, over the cost of raking, baling, loading, trucking and shipment by rail to the mill, which included all handling labor at the prevailing rate. The yield for this area averaged ¾ ton per acre.

Those who process flax straw have complained that, while combined straw had a better fiber length than threshed straw, it is dry and brittle, and the fibers break easily during processing. This is due to allowing the combined straw to lie on the ground until the entire seed harvest is over; the rains and sun naturally have a leaching effect on it.

If the grower desires to benefit to a maximum from his flax straw crop, he will find it helpful to consider the following suggestions:

1 If windrowed, the maximum fiber length and tonnage can be obtained by cutting close to the ground, at the same time reducing the length of stubble plowed under or burned off.

2 To avoid drying out the natural plant juices and leaving the straw excessively dry and brittle, it is well to windrow only sufficient flax ahead of combine operations to insure uninterrupted operation when weather permits.

3 Use a combine equipped wih a rubber-roll feeder for minimum damaged fiber length, obtain maximum amount of seed with minimum cracking, and avoid grinding up weeds and other extraneous matter in the threshing operation, to the detriment of the seed classification quality. With flax-roller-equipped combines, of which there are several on the market, the flax bolls are cracked by the crushing action of the rollers. The cylinder on a properly equipped machine is operated at under normal small grain speed—about 4000 fpm—and is set in a raised position. Its sole function is to agitate the straw and thoroughly shake all seed out of the crushed bolls, and to pass the straw onto the separating mechanisms. No straw damage or towing is done on the rubber-roll-equipped combine, as the cylinder does not grind the seed out of the pods, as an ordinary machine would.

4 The straw should be baled promptly after combining so as to retain the essential plant juices. This also maintains straw weight, and consequently the price to grower for straw tonnage.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

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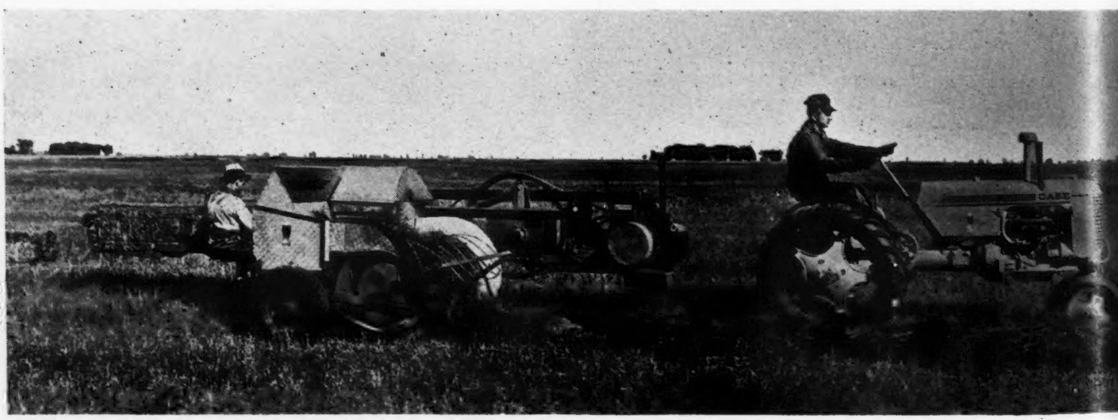


Baling flax straw from the windrow left by the combine

Handling Baled Hay and Straw, Field to Storage

A DISCUSSION of present methods of handling bales was held during a meeting of the Committee on Hay Harvesting and Storage of the American Society of Agricultural Engineers at Chicago on December 11 and 12 for the purpose of bringing out those methods which are most efficient.

This problem of handling and storing baled hay and straw may be divided into three phases:

1 Collecting and loading bales in the field
2 Transporting the bales to the place of storage
3 Elevating and stacking the bales in the storage space.

The most common method of collecting and loading is to drive a wagon or truck through the field and load the bales by hand. Probably next in general use is the method of extending a chute from the rear of the baler, which allows the baler to push the bales up to the floor level of a platform wagon which is trailed behind the baler. One extra man thus loads the wagon as fast as the bales are made. However, it is strenuous work when the load gets high, and members of the baling crew may take turns at loading. No extra power is required for loading with this method since the baler plunger pushes the bales up the chute and the column of bales provides part of the resistance needed to compress the bales for tying. This method of loading requires little extra equipment and eliminates lifting the bales from the ground to the platform level. It also gets the bales out of the field and safe from the weather as fast as they are made. It is not suitable for use with a truck, and changing wagons slows up the outfit slightly.

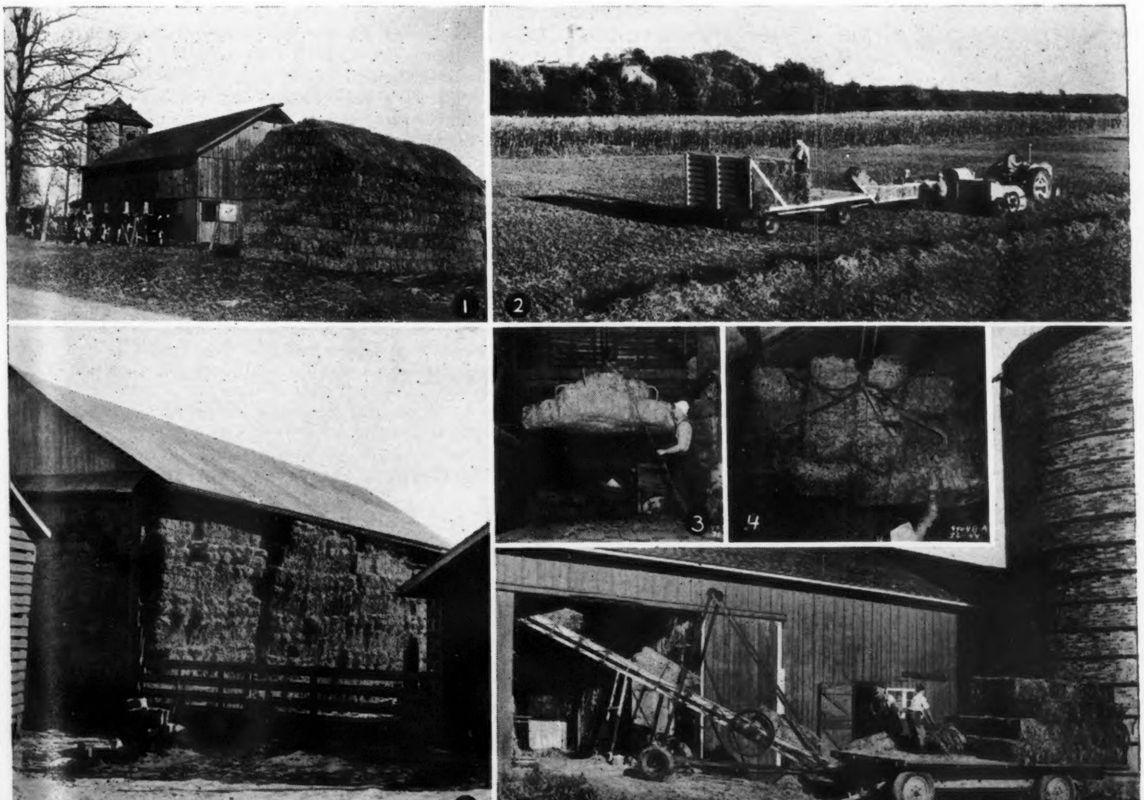
This article is a contribution of the Committee on Hay Harvesting and Storage of the American Society of Agricultural Engineers, and was compiled jointly by L. G. Samsel and C. B. Richey, members of the Committee.

A variation of the foregoing method is to use a dump trailer behind the baler. A man usually stacks the bales on the trailer, and this load is dumped at the end of the field to reduce the travel required for collecting. Some operators eliminate the man and let a few bales pile up as they will, and then dump in windrows without stopping.

Many mechanical bale loaders for attachment to trucks, wagons, or trailers have been constructed by mechanically minded farmers and some are undergoing commercial development. One of the latter attaches to a tractor for loading in the field, and when the tractor has pulled the wagon to the barn, the attached loader can be hooked to an extension elevator and used to elevate the bales into the mow. These mechanical loaders eliminate the work of lifting the bales from the ground to platform level, and most of them deliver high enough to reduce materially the labor of stacking the bales on the wagon platforms. Two men are required, one driving and the other loading.

Except possibly on rolling land, bales do not require transport wagons with sides. A simple platform on a low-wheeled wagon is usually sufficient. On hilly fields skids are being used in lieu of wagons.

Elevation of the bales to the mow and stacking them in place may be accomplished by several methods. The most popular is probably the use of a grapple type fork or sling to hoist as many as 8 to 10 bales at a time. Coupled to an overhead carrier the load of bales can be spotted at any point over the full length of the barn mow or storage shed. A padding of loose hay or straw is used by some growers to avoid the possibility of broken bales in



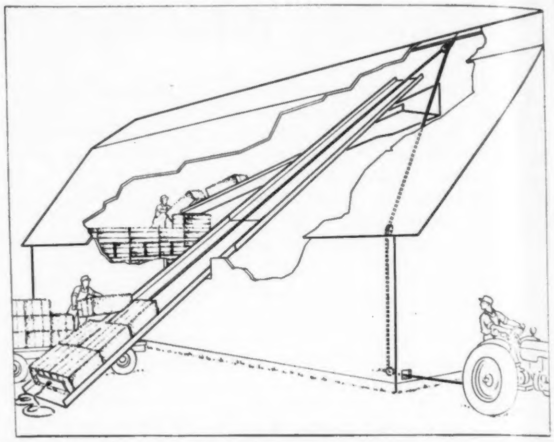
These pictures show typical methods of handling baled hay and straw, from field to storage, now used by farmers. Views 1 and 5 illustrate two methods of storing bales. In view 2 the baler pushes the bales as made up a chute and onto a platform wagon. A grapple type fork for elevating bales from wagon or barn floor to the mow is shown in views 3 and 4. View 6 shows a portable elevator in use for getting bales in mow

the first layer, but even this precaution is not considered necessary if the bales are well tied and the drop is not too great.

Many farmers are using portable ear corn elevators to lift the bales into the barn mow. Not all the present makes of elevators can be adapted for this, but manufacturers are said to be giving special consideration to elevating bales. Some farmers have built their own simple bale elevators and in the East straw carriers built for threshers are being utilized. Compared with the grapple fork, the elevator eliminates the need for hay carrier equipment and can be used in any building or for an outside stack. It is easy on the bales and delivers them one at a time, facilitating stacking. On the other hand, they usually deliver only to one spot and the bales may require more hand labor for stacking in the mow than when the grapple fork or sling is used.

One farmer has developed an ingenious homemade bale slide, which extends from the ground to the hayloft and can be extended in length to deliver the bales continually to the top of the stack. The slide is two bales wide and the bales are placed on the slide in pairs, two. four, six, or more being handled at one time. The column of bales is elevated by a footboard and rope. The rope extends through an upper pulley at the far end of the slide and then to a ground-level pulley where the power is applied by horse, electric motor, or automobile as the case may be. The group of bales is pulled over the end of the slide and a small rope is used to pull back the footboard and hoist rope for the next load.

Where conventional elevators can deliver bales high above the mow floor, it might be advantageous to use a movable delivery chute which would let the bales slide farther into the mow. This chute could be adjustable as to length and delivery height so as to reduce the work of stacking.



This sketch shows an ingenious homemade slide for elevating bales to a hay loft or stack, together with a movable delivery chute for placing bales in the mow

Ground floor storage, where the wagon or truck can be driven in and the bales unloaded directly on the stack, requires the least labor for storage and this fact will undoubtedly influence future farm building design.

Mechanical Loaders

By J. W. Slosser

MEMBER A.S.A.E.

DEVELOPMENT in the past few years of mechanical loading devices for potatoes by potato growers of Aroostook County, Maine, will be of general interest to agricultural engineers. For many years potatoes in Aroostook County have been picked in barrels and loaded on motor trucks or wagons by hand. In the fall of 1942, due to the war-induced man power shortage, a few farmers devised mechanical barrel loaders. These proved so effective that by the fall of 1944 there were at least seven different types available. Some were hydraulically or pneumatically operated, while others used mechanical means such as the drum and cable. In some cases a separate engine was used for power, while in others the power was furnished by the truck engine. Many large operators mount the barrel loader or lifter on a tractor and thus serve several trucks with the one unit.

Prior to the coming of these mechanical loaders, a crew of four men was generally used in the loading operation. One man was required to drive the motor truck and another to place the barrels on the truck. Two men were used to lift the filled barrels from the ground to the truck bed—a vertical distance of 32 to 36 in. The total weight of a barrel filled with potatoes averages around 200 lb gross.

With the mechanical loader, a crew of two — or, at the most three — is all that is required, and since physical exertion has been greatly reduced, two members of the crew can be replaced by women. In the accompanying pictures, the view at the left shows a hydraulic-operated barrel loader mounted on a truck and operated by a gas engine; the unit occupies the space of one barrel. The view at the right shows the barrel loader in operation. In this case a woman places the grapple on the barrel and trips the loader, and the man on the truck removes the grapple and places the barrel on the truck bed. Incidentally, this operation is possible with the truck in motion, as it is not necessary to stop the truck unless several filled barrels are placed adjacent to each other.

As to performance, the equipment shown in the pictures is normally able to pick up a full load (27 barrels) in 8 to 12 min. Some operators have reported a total loading for one unit of 2500 barrels in one day with a crew of three.

It occurs to me that the device shown, or modifications of it, can be applied to other heavy farm field jobs, not only to relieve critical labor shortages, but also to reduce to some extent heavy physical labor required in many farm jobs.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

J. W. SLOSSER is a project supervisor of the Soil Conservation Service, U. S. Department of Agriculture.

(Left) This view shows a hydraulic-operated barrel loader powered by a gas engine and mounted on a motor truck. (Right) This picture shows the mechanical barrel loader in operation

The Effect of Structure Changes in Houston Clay on Plant Development and Water Relationships

By Russell Woodburn
MEMBER A.S.A.E.

STUDIES relating to the physical nature of soil would appear to be of particular importance at this time as prerequisite for and contemporary with studies of plants and fertilizers.

Tillage may make vast changes in the structure of a heavy clay soil. The undisturbed material in place in the subsoil, and in some cases even very close to the surface, is frequently very compact and dense in nature and has but little water-conducting capacity. The portion of the soil exposed by preparation practices to weathering forces changes markedly in structure. Alternate wetting and drying cause the large clods of plowed-up material or any other exposed surface to slake into granules or fragments, which may be described as aggregates. Obviously physical properties such as volume weight, field capacity, permeability, total porosity and non-capillary porosity, as well as plant response, are greatly altered.

Houston clay, common to the northeast prairie section of Mississippi, is a typical example of a soil with the behavior just described.

Jones and others[2]* say, "Houston clay is very hard to handle in most seedbed preparation practices. This soil turns up in large clods or flakes, and only nature (by wetting and drying) can reduce the clods without excessive cost. If this soil is handled in late spring and planted without much moisture, it is almost impossible to obtain a good stand of cotton."

The effect of alternate drying and wetting on the formation of water-stable fragments or aggregates has been pointed out by Woodburn[6], with particular attention to the continuous decrease in aggregate size with each drying-wetting cycle.

Some moisture-structure relationships for Houston black clay of Texas have been pointed out by Stoltenburg and Lauritzen[5]. These investigators used moisture equivalent as an index of micropore space or capillary porosity, whereas water-holding capacity against gravity (field capacity) is taken as a measure of capillary porosity in this paper. It is the purpose here to present some results from studies of the physical properties of Houston clay of Mississippi as they are related to plant development, water-holding capacity and permeability.

PROCEDURE

Cylinders 6½ in in diameter and 18 in long (20-gage sheet iron) were jacked into the soil for obtaining samples of undisturbed Houston clay subsoil 6 to 24 in in depth. Readings on the soil surface within the cylinders were made with an engineer's level before and after jacking. Compression of the profile by the jacking process was found to average ⅜ in for an 18-in depth.

A portion of the same subsoil material was placed upon a concrete platform, exposed to the sun and the rain. During the month of exposure, from July 25 to August 25, about 5½ in of rain fell and the material was well slaked into granular fragments or aggregates by the many drying-wetting cycles which it had undergone. This material was used to fill the cylinders described as aggregated subsoil. Particular attention is directed to the fact that naturally produced fragments were used. This material might have properties different from those of mechanically produced clods (Smith[4]).

Houston clay topsoil to a depth of ½ in and very well slaked and granulated was used to fill the cylinders hereafter described as aggregated topsoil. The topsoil used in this study was little, if anything, more than subsoil material which had undergone a great many drying-wetting cycles through normal weather exposure. There was, however, a small amount of organic trash present. A complete record of weights and moisture percentages was obtained when the cylinders were filled in order to determine the moisture-free weight of the soil. The dry weight of the soil in each cylinder was the basis for many of the calculations subsequently made.

The cylinders of *subsoil in place, aggregated subsoil* and *aggregated topsoil* were divided into two groups after the cotton was planted in them September 7, 1944.

One group of cylinders received distilled water only and the other group received a complete nutrient solution. Addition of the nutrient solution was started on September 19 when the cotton was several inches high. This portion of the experiment was conducted in a greenhouse as little cotton growth would have been obtained outdoors at this time of year.

The cotton plants were harvested November 24, and green weights were obtained. At this time, permeability rates were determined by means of large burettes suspended over the cylinders. The method was essentially that used by Free, Browning and Musgrave[1] for determination of infiltration rates. The permeability rates reported were equilibrium rates at the end of 3 or 4 hr.

The cylinders had a double screen wire over the lower end and were resting on a smooth board during the tests. No sand bed or base was used under the cylinders. After the cylinders had been receiving water for several hours, they were quickly removed and weighed for determination of total amount of water present under maximum water-conduction conditions.

After gravity drainage for 24 hr or more, with the tops covered against evaporation, the cylinders were reweighed for determination of moisture-holding capacity (roughly, field capacity). Repeat tests gave practically constant values for weight of the cylinders after gravity drainage. Total voids were computed from volume weight and specific gravity (2.62).

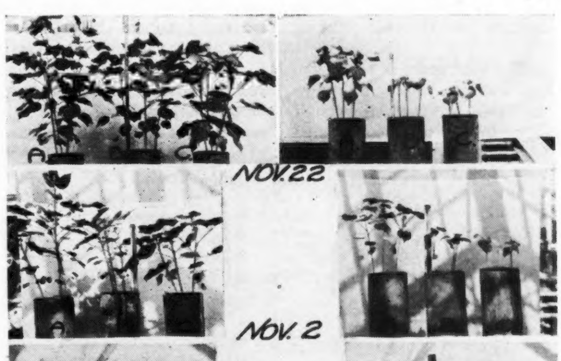


Fig. 1 Development, at four dates, of cotton planted September 7, 1944, in Houston clay in three different physical conditions: A, finely granulated or aggregated topsoil; B, granulated or aggregated subsoil; C, subsoil in place. Left: Complete nutrient solution. Right: Distilled water only

A paper presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Georgia, February, 1945. A contribution from the department of agricultural engineering, Mississippi Agricultural Experiment Station and the Soil Conservation Service (Research), U. S. Department of Agriculture. Published with the approval of the director, Mississippi Agricultural Experiment Station, as paper No. 95, new series.

RUSSELL WOODBURN is project supervisor (research), Soil Conservation Service, U. S. Department of Agriculture.

AUTHOR'S NOTE: Acknowledgment is made to Dr. O. A. Leonard, plant physiologist, department of agricultural engineering, Mississippi Agricultural Experiment Station, for valuable assistance in planning and conducting the nutrient phases of the study.

*Superscript numbers refer to the bibliography at end of paper.

RESULTS AND DISCUSSION

Fig. 1 presents the history of the cotton plants until the plants were cut for weighing November 24. The green weights of the plants at the time of cutting are shown in Table 1. The plants given different treatments differed in weights even more strikingly than in appearance.

In both the nutrient-treated group and the group without nutrients, the aggregated subsoil appeared to be equal to the subsoil in place. The more finely aggregated or granulated topsoil was the best under both nutrient conditions. The pictures of the plants and the green weights indicate beyond question the value of the nutrients under all three physical conditions shown.

It was somewhat surprising that the aggregated subsoil showed so little improvement over the undisturbed dense subsoil.

It has been pointed out by Leonard[3] that aeration is poor in undisturbed Houston clay subsoil. Aeration was undoubtedly good in the cylinders of aggregated subsoil. The relative coarseness of the aggregates and looseness of structure (see volume weight and permeability in Table 1) could have been factors in holding the yield down, even with good aeration. The larger size of granules may have resulted in insufficient root contact surface.

In Table 1, porosity and permeability data for all cylinders are shown. It was assumed that the water held against gravity (field moisture) was in pores generally too small to be of much value in conducting water. The tiny voids in the granules or fragments themselves (both aggregated conditions) probably were responsible for the greater portion of the water held at field capacity. Therefore it was considered that the field-moisture volume represented capillary porosity of little probable participation in the equilibrium permeability rates shown.

The difference between total void space and field-moisture space was computed and was considered to be maximum non-capillary porosity. These values are shown in Table 1 in the column headed "Method 1". This was but slightly lower on the cylinders of aggregated topsoil than on the aggregated subsoil. However, the permeability of the latter was much higher. The low correlation between non-capillary porosity calculated in this way and permeability indicates either a considerable difference in size of the non-capillary pores between aggregated subsoil and aggregated topsoil or a possibility that some of the non-capillary pores were air filled and were not conducting water under the conditions of the experiment. There is also the possibility that some air may have been entrapped in some of the fine pores when field capacity was obtained, making these values subject to some error.

In order to get at this question, unfilled void space at field capacity was also calculated in another way, with the results, as shown in the column headed "Method 2" in Table 1. The cylinders of aggregated subsoil contained the same material as the unaggregated subsoil cores. (This is largely true for the topsoil cylinders also.) It was assumed, therefore, that the volume weight of the wet aggregates themselves at field capacity would be approximately the same as that of the wet unaggregated material at field capacity, (little or no air present). This volume weight was found to average 1.76 on the 6 cylinders of undisturbed subsoil at field capacity. From the weight of the wet aggregated material in the cylinders and the volume weight, 1.76, the volume of actual aggregates was obtained. Subtracting this volume from the soil volume in the cylinders would leave the volume of the pores between aggregates or fragments. The assumptions made appear to be valid, as the unfilled void space at field capacity calculated by method 2 is either the same or fairly close to that calculated by method 1.

Therefore, it would appear that the water held at field capacity was largely in the tiny pores in the fragments or aggregates and the water-free space was between the aggregates.

A more reliable picture of water-conducting non-capillary porosity is probably obtained by using the water space at saturation rather than total void space in the cylinder. When total water space at field moisture is subtracted from total water space at saturation, the result may more nearly represent water carrying pores or *effective* non-capillary porosity.

It may be seen in Table 1 that in no case did water space at saturation equal total void space. Even when the cylinders were carrying all the water possible, it appears that some of the *non*-capillary pores were air filled and not carrying water. The difference between total water space at saturation and total water space at field capacity would, therefore, appear to be a fair approximation of the amount of *effective water-carrying* non-capillary porosity for the cylinders of granulated material. Some correlation is actually evident between the water-carrying pores calculated in this way and observed permeability rates.

It is emphasized that the *effective non-capillary* porosity calculated in this way represents the water-carrying capacity of an 18-in deep sample of granular material well settled for a period of 2½ months. The values reported were obtained under conditions of gravity forces only being operative. If some external suction or tension had been applied by means of a deep sand base under the cylinders, or in some other way, the field moisture capacities would have probably been lowered somewhat. Likewise, water-carrying capacity at saturation might have been increased somewhat by air being drawn out of some of the smaller non-capillary spaces by external tension. The net result would, therefore, have been an increase in the *effective* non-capillary pore space obtained.

It is believed that the concept of *effective* non-capillary pore space described in this paper may have some value in drainage investigations where a profile at saturation or even with surface impoundage would be encountered.

TABLE 1. YIELDS, POROSITY AND PERMEABILITY

Cylinder	Green weight cotton plants, g	Volume weight	Field capacity, per cent dry weight	Field capacity, per cent total vol. (Capillary porosity)	Total voids, per cent of volume	Unfilled voids at field capacity, per cent of volume (Non-capillary porosity) Method 1	Method 2	Saturation capacity, per cent total volume	Water-conducting space at saturation, per cent total vol. (Effective non-capillary porosity)	Permeability, iph
				Complete Nutrient Solution Added						
Subsoil in place										
No. 1	151	1.23	41.4	51.0	53.0					0.20
2	130	1.25	42.4	53.0	52.0					0.00
5	133	1.23	41.9	52.0	53.0					0.03
Granulated subsoil										
12	137	0.95	43.6	41.7	63.7	22.0	22.2	50 5	8.8	14.5
15	143	0.96	43.8	42.2	63.3	21.1	21.8	51.0	8.8	12.0
Granulated topsoil										
14	173	1.08	36.2	39.1	58.7	19.6	16.0	44.2	5.1	3.7
17	193	1.05	39.3	41.2	60.0	18.8	16.8	46.3	5.1	6.6
				No Nutrient Solution Added						
Subsoil in place										
3	8	1.24	40.6	51.0	53.0					0.06
4	10	1.23	41.5	47.0	53.0					0.15
6	3	1.28	39.8	51.0	51.0					0.00
Granulated subsoil										
7	7	0.97	44.2	42.8	63.0	20.2	21.5	50.9	8.1	19.4
8	8	0.98	44.2	43.3	62.6	19.3	19.5	51.8	8.5	24.5
9	8	0.96	43.7	42.0	63.3	21.3	21.5	50.2	8.2	14.4
Granulated topsoil										
10	38	1 04	37.3	38.8	60.3	21.5	19.1	43.3	4.5	14.0
11	35	1.07	37.7	40.4	59.2	18.8	16.3	45.2	4.8	10.1
16	41	1.06	38.5	40.8	59.5	18.7	16.3	45.2	4.4	8.8

It is not known whether lateral movement of water in fragmented or aggregated Houston clay topsoil or subsoil would behave in exactly the same way as the vertical movements reported herein. It is, however, believed that considerable lateral drainage could develop in deeply aggregated material on appreciable slopes. This would be of some advantage where water could not go downward into the undisturbed tight subsoil.

SUMMARY AND CONCLUSIONS

1 Samples of Houston clay in three different physical conditions were compared as to porosity, water retention and conduction, and plant response. The three conditions were as follows:

(a) Topsoil, slaked into fine fragments or aggregates.

(b) Subsoil (6 to 24 in) slaked into coarse fragments or aggregates.

(c) Subsoil in place, dense and compact.

2 Plant response was little, if any, better on the coarsely aggregated subsoil than on the dense, compact subsoil, in spite of improved aeration. The more finely granulated material represented by the topsoil was superior to the subsoil, either undisturbed or in fragments. Better root contact, resulting from the finer fragments or aggregates, was thought to be a factor here.

3 The plants that received a complete nutrient solution were far superior to those receiving distilled water only, for all three physical conditions.

4 Void percentage occupied by water at field capacity was calculated and assumed to be capillary porosity or non-effective water-conducting space under equilibrium permeability conditions.

5 Non-capillary void percentage was calculated by subtracting capillary voids from total voids and also by subtracting volume of wet aggregates from total volume. Results obtained by the two methods were in reasonable agreement.

6 There was little correlation between non-capillary voids and observed permeability rates. It was assumed that some of even the non-capillary voids contained air at saturation.

7 *Effective non-capillary* void percentage was calculated by subtracting water space at field moisture from water space at saturation. Some correlation with observed permeability rates was evident. Effective non-capillary porosity was greater in all cases on the coarsely granulated subsoil than on the topsoil.

8 Field moisture space for the undisturbed Houston clay subsoil was about the same as total void space, indicating that only capillary pore space was present. This was verified by the very low permeability rate. There was considerable non-capillary pore space on all cylinders of aggregated or granulated material.

9 Permeability rates were lower in all cases on the cylinders of granulated material having cotton with nutrients than on those without nutrients. It was assumed that the more extensive root systems on the nutrient cylinders offered more obstruction to water flow.

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"The Self-Propelled Combine"

TO THE EDITOR:

I WAS interested in the papers by Tucker and Pool in AGRICULTURAL ENGINEERING for September, 1944, on the self-propelled combine. Perhaps a few observations on the other side of the subject will be of interest to someone. But first let me say that I am all for any improvements that will increase the efficiency of farming, and I do believe that there is an open field for self-propelled implements.

There are a few points for which great advantage is claimed but with which I cannot agree. This last year (1944) I cut 1100 acres of wheat, averaging over 20 bu per acre, with two 12-ft tractor-drawn combines. These machines were operated as one-man units. That is, the man on the tractor operated the combine, and we find he can do a better job than two men. He is in a better position to see and hear the combine than he would be if he were on the platform intended for the combine operator. Most of the farmers with 12-ft combines in this area have been operating their outfits with one man and have been so successful that several farmers with 16 and 20-ft machines are planning to make the necessary changes of controls so that they can be operated from the tractor. One neighbor cut 300 acres of grain sorghum this last fall with a 16-ft combine operated from the tractor.

Some combines have the controls located conveniently for the tractor operator and others have not. The most successful method of controlling the header has been to use an electric starter motor wired so that it can be reversed and belted or connected with the lifting mechanism of the combine by the proper reduction gear. A worm gear or screw is very desirable because of its non-reversible characteristic. The electric control in most cases can be energized from the battery on the tractor—or from a battery set on the combine, and the battery recharged when necessary. Under ordinary conditions one charging will last several days. The electric control has the advantage over manual control in that very little physical strength is required. This last year my 12-year-old son ran one outfit a large part of the time and did a very good job too. I don't advocate using young children in the harvest field, but this illustrates what can be done in an emergency when the proper equipment is available.

The weakness of so many power-take-off-driven machines, that has forced farmers to install auxiliary engines, has not been eliminated in the self-propelled combine. The flexibility or independence between the operation and travel of most machines is very desirable. I have pulled my combine as fast as 10 miles per hour in thin or light straw, and coming into a heavy spot or where the wheat has lodged, I have slowed down to a mere creep, all with the use of the throttle and without stopping to change gears. I am sure that the operator can feed his machine much more uniformly by throttle control on the tractor than any other way I know of. If the self-propelled combines were equipped with flexible transmissions such as the hydraulic drives used on some industrial machines, or like the old friction-disk drives, they might obtain the desired independence of travel and operation with one engine.

There is some advantage with the self-propelled combine in opening fields, especially in an area of small fields, but I see no reason for claiming that an 8-ft strip is lost. It is true that some custom cutters and poor farmers think more about getting through than cleaning up the field, and so leave the backswath uncut, but I find that, if the runover wheat is cut immediately with the cutting bar set low, very little grain is lost; and sometimes, if the straw is heavy, it will pick up perfectly clean. The width that will be knocked down will seldom exceed three feet.

This last season we had a lot of rain during harvest (11½ in falling in 8 showers) and the ground got rather soft. We put a larger tractor on the combine and went ahead, while a neighbor whose wheat was being cut by one of the fleet of self-propelled combines saw the operator get disgusted and pull out and leave him for drier fields farther north.

The self-propelled machine can operate on less fuel per acre than a two-unit outfit. Even with lodged grain and heavy pulling I used only 5 qt per acre to harvest the grain. That includes the gasoline in the truck, tractor and combine.

It has been suggested that self-powered units will release the tractor for other work, which is true, but I wish someone would tell me where to find the man power to operate them during the rush of the harvest season.

Our biggest worry right now in the wheat business is getting our wheat marketed. The railroad car shortage will not let the wheat move out of farm storage and release bin space for another big crop that is in prospect.

HUGH E. WHITE

Member A.S.A.E.
Farmer, Ford County, Kansas

The Design of Drainage Systems

By John G. Sutton
MEMBER A.S.A.E.

THE design of drainage systems is a broad subject to which a full textbook might readily be devoted. I will not attempt to summarize the entire subject in a brief paper but will call attention to some of the problems met in the design of drains, with particular reference to farm drainage conditions in the northeastern states of the United States.

Throughout the United States interest in land drainage is on the increase and has been for several years. Soil conservation districts are furnishing technical assistance to farmers, and considerable interest in farm drainage and group drainage has been noted in many of the districts. In the Northeast, considerable farm drainage work has already been completed in 16 soil conservation districts. In New York, 15 surveys have been prepared on community jobs and 8 jobs have been completed or are under construction. There is considerable interest in the upper part of New York in drainage of muck land for growing truck crops. In Delaware and Maryland, a large amount of drainage work is under way on the eastern shore and several years' work is ahead. The American Society of Agricultural Engineers should give full consideration to the technical and related problems involved in land drainage and many members can make worth-while contributions toward solution of these problems.

I would like to dwell briefly on some of the general trends and problems in land drainage so that we can relate problems in design with broader problems of drainage. First, we may classify drainage problems and systems into two distinct kinds, farm drains and community type or group drains. Farm drains may usually be installed by an individual landowner where the land slope is sufficient, or a natural stream is available, to provide an adequate outlet on the farm. A community drain serves more than one farm and is constructed by a drainage enterprise which may be a drainage district, a tax ditch, a county, a town, a corporation, or a voluntary group.

The rights of landowners to construct drains and their responsibilities when they construct them are greatly affected by state laws covering construction of artificial drains. Some states follow the civil-law rule and others the common-enemy or common-law rule in land drainage, and these rules, as applied in a state, should be understood by an engineer engaging in drainage work. Under the civil-law rule a landowner may improve his land by artificial drainage so long as he does not change the location of the outlet leaving his property and does not divert water from another watershed. The lower owner has no right to obstruct water from higher lands. In states following this rule the lands assessed for benefits for community drains are limited to those directly benefited by lowered water table or by improved flow conditions. Also, under this rule a landowner may install farm drains without responsibility for the effects downstream. Maryland and Pennsylvania follow the civil-law rule.

The common-enemy or common-law rule means that the landowner may protect his land from water flowing from higher lands, and therefore the higher proprietor has no easement enabling him to drain his water by artificial channels upon lower land. In states which follow this rule, the landowner is responsible for increased flow due to the construction of artificial channels and, as a result, land lying well above an area actually benefited by group drains may be assessed. In some states, such as Indiana, the effect of this rule is that the entire area in the watershed is likely to contribute financially to community outlets. In Indiana, 43 per cent of the area of the state is included in drainage enterprises, and many community outlets have been installed which would not be feasible in states following the civil-law rule. Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, and New York follow the common-enemy rule.

The effects of these differences in the law on the design and installation of drains are apparent. In states following the civil-law rule the designer of farm drains has greater freedom and less restrictions. In states following the common-enemy rule we must give careful study to the effect of drains on lower lying lands, and it would often be desirable to integrate farm drains into a community system to avoid legal troubles. Because at least six states in the Northeast follow this rule, it is of particular significance in future drainage work in this section. None of these six states has any organized group drains listed in the drainage census.

The 1940 drainage census shows that there are 87 million acres of land in organized drainage enterprises. There are only two states, Maryland and Delaware, among the northeastern states that have organized drainage enterprises. It is believed that the absence of land drained by community drains in some states is affected by:

1 Lack of a workable state drainage code or complex state laws and procedure
2 Customs and habits of farmers
3 Low ratio of benefits to costs
4 Lack of interest by leaders in the state.

In several states there is need for and possibilities of community and farm drainage far beyond what has already been developed. In some states the opportunities in drainage are great and should affect the agriculture of the state appreciably. Possibly the best guide to the drainage opportunities and needs is the preliminary estimates of drainage needs in the northeastern states shown in Table 1. The estimates are preliminary figures of the U. S. Soil Conservation Service and are subject to change as additional data are developed.

The design of open drains may be developed in the following steps. (These steps cover larger outlet systems):

1 Determining that the system will be comparatively free from the effects of erosion and siltation, and planning remedial measures necessary.
2 Determining of watershed area.
3 Selecting of drainage coefficients or runoff coefficients to be used in computing the size of ditch.
4 Establishing a hydraulic gradient for the proposed ditch.
5 Establishing minimum depth and side slopes of drain.
6 Determining of the maximum allowable velocity based on soil type.
7 Determining of ditch size based on Kutter's or Manning's formulas.
8 Planning auxiliary structures, operations, and maintenance practices, including bridges, culverts, inlet structures, headwalls, and bank protection for open ditches.
9 Designing of laterals and farm drains to discharge into main drain, including tile drains and open drains.

Several of these steps are standard hydraulic procedures and are covered in many works on hydraulics and drainage and will not be

TABLE 1. LAND IN NEED OF DRAINAGE IN THE NORTHEAST STATES (PRELIMINARY ESTIMATES)

	Community drainage				Farm drainage
			Land in organized drainage enterprises		
State	Wet and overflow lands not in drainage enterprises, acres	Area which could be drained by community drains at reasonable cost, acres*	State total acres†	Area needing rehabilitation work, acres	Land in need of farm drains, acres
Connecticut	127,000	30,000			2,251
Delaware	148,000	25,000	395,014	139,000	331,338
Maine	1,335,000	88,000			5,034
Maryland	423,000		183,337		593,863
Massachusetts	172,000	37,000			2,873
New Hampshire	125,000	21,000			1,697
New Jersey	655,000	110,000			10,292
New York	1,091,000	170,000			155,872
Pennsylvania	398,000	149,000			129,540
Rhode Island	33,000	7,000			280
Vermont	88,000	27,000			5,347
West Virginia	244,000	49,000			31,442
Regional total	4,839,000		578,351		1,269,829

*Represents a portion of land in preceding column.
†From 1940 Drainage Census

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discussed in this paper. As discussed in the following paragraphs, however, special problems do exist in some of the steps.

Step 1. Determining that the system will be comparatively free from the effects of erosion and siltation, and planning remedial measures necessary.

I am listing as step 1 the determination that the drainage system will be free from siltation and the effects of erosion and that remedial measures should be planned because this is one of the most important steps in the proper planning of the drainage system. There are many areas in the northeastern states where erosion is a severe problem and contributes much silt to ditches and low-lying lands. Many of the drainage problems involve the draining of bottom lands adjacent to eroding hills, and it is on this type of area that many of the past failures in drainage have occurred.

Many ditches have been dug for the purpose of draining bottom lands but have filled up within 1 to 4 years. Such drainage resulted in much loss and criticism. Areas subject to erosion should be avoided until the erosion problem is solved or remedial measures are planned and carried into effect. The remedial measures include a soil conservation program on the hill lands and installation of measures necessary to control gullies and stream-bank erosion. The planning of such measures and their installation by farmers require a long time for adequate control on a watershed basis. Often the landowners of bottom lands wish to make improvements and utilize their bottom lands before erosion-control measures become fully effective on the uplands. In such cases silt basins have been used advantageously in some areas. They require careful planning, based on the local situation, and increase the cost of the drainage system.

In one case in Georgia, the Soil Conservation Service is now investigating a plan to place a dam across a valley and utilize the upper part of the valley for detention of flood waters and silt in order that the lower part of the bottom lands may be drained at a reasonable cost. In this case it may be necessary to sacrifice about as many acres of bottom land for flood storage and silt protection as would be drained below the dam. In some areas it is better to reclaim only the higher of the bottom lands and not attempt to utilize the lower lands for cultivated crops. Hay and good pasture can be secured from many bottom lands that are too wet to be used for row crops.

Step 2. Determining of watershed area.

Aerial photographs, topographical maps, and other maps are usually available to determine watershed areas accurately enough for the design of drainage ditches. In this connection it is desirable to consider diversion of water around wet areas. In handling farm drainage problems, good results are often secured by diversion of water away from fields to be drained.

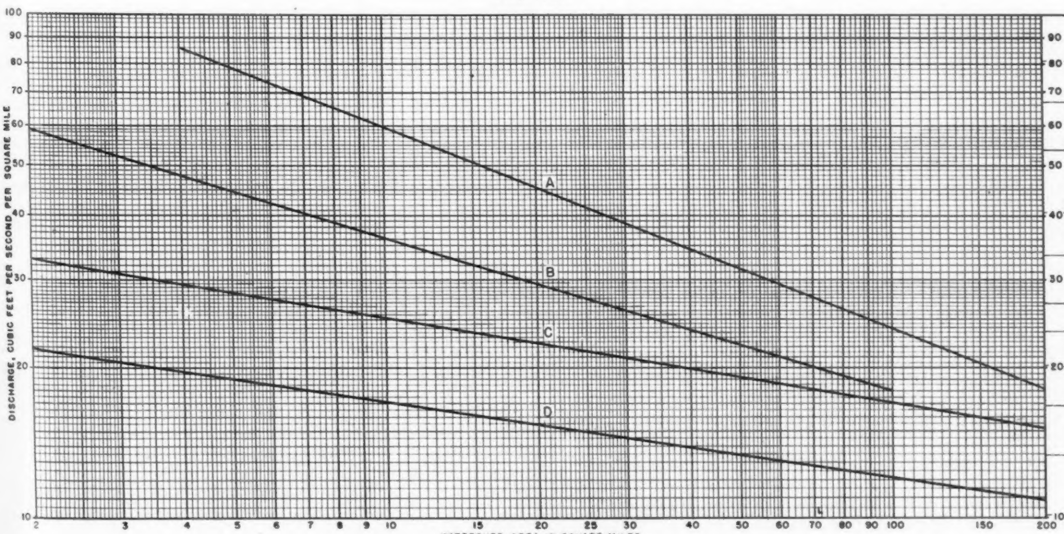
Step 3. Selecting drainage or runoff coefficients to be used in computing the size of ditch.

Additional work is needed, especially in the northeastern states, in determining the proper drainage or runoff coefficients to be used in designing ditches. At present the Soil Conservation Service relies chiefly on curves developed in other areas for design of ditches. Some years ago I developed the curves, in the accompanying graph, showing recommended capacity of drainage ditches in the several midwestern states, which have been widely used in the design of drainage works in these areas. These curves were developed primarily from measurements of flow in drainage ditches which were made by engineers in the field following heavy rains.

On one occasion some years ago there was a heavy rain in June near Elyria, Ohio. The rain occurred in the night and Fred F. Shafer, a drainage engineer with our agency. inspected the area the following morning. He observed that the ditches, which had been rehabilitated and cleaned out just prior to that time, did not overflow. Those which had not been cleaned out overflowed and water was standing on the fields. In June of the year such an overflow causes crop damage and ditches should be large enough to prevent frequent overflow. Such observations enabled us to judge that these ditches, of known size, were adequate in capacity.

I recall one ditch in northwestern Ohio that had been rehabilitated by a CCC drainage camp. The ditch had a very small capacity before it was cleaned out and a design was prepared for a ditch which some of the farmers thought would be too large. In one 24-hour period a rain of at least 4 inches occurred and many of the farmers gathered by the ditch to see whether it would overflow. The water rose gradually and reached a crest a few inches below the low-lying fields. The farmers stood along the ditch with an employee of our agency as the water reached its crest, and all agreed that the ditch was just about the right capacity. If overflow had

CURVES SHOWING "RUNOFF TO BE ALLOWED" OR THE "DRAINAGE COEFFICIENTS" TO ACCOMPANY ARTICLE "HYDRAULICS OF OPEN DITCHES" BY JOHN G. SUTTON, IN AGRICULTURAL ENGINEERING, MAY, 1939



A FOR GOOD PROTECTION FROM OVERFLOW (NOT MAXIMUM FLOOD RUNOFF)

B FOR EXCELLENT DRAINAGE

C FOR VERY GOOD AGRICULTURAL DRAINAGE IN OHIO, IND., ILL., IOWA, AND NORTHERN MO
FOR GOOD AGRICULTURAL DRAINAGE IN KY. AND SOUTHERN MO.

D FOR FAIR AGRICULTURAL DRAINAGE IN OHIO, IND., ILL., IOWA, AND NORTHERN MO

NOTES WATERSHED AREA TO BE DETERMINED ABOVE EACH SECTION OF A DITCH FOR WHICH CAPACITY IS TO BE COMPUTED
APPLICABLE ONLY TO FLAT WATERSHED AREAS HAVING AVERAGE SLOPE LESS THAN 25 FEET PER MILE.

occurred, considerable crop damage would have resulted. However, the ditch took care of the runoff during a critical period in the growth of the crops and no damage resulted.

At that time we had about 30 CCC camps working on drainage in the midwestern states. Many of these camps had current meters and engineers made measurements following heavy rains. We had many measurements under conditions similar to those which I have described in Ohio. These data were used as a basis for developing the recommended curves shown in the graph. These curves have given good results in the prairie lands in the Midwest. Their limitations should be recognized and they should not be used for areas where they are not adapted or in places which have different rainfall characteristics. They are limited to comparatively flat areas, and, as stated on the face of the curve, they apply to areas where the slope of the watershed is less than 10 feet per mile. There are many problems in the hill areas where runoff from steeper lands must be taken into account and a higher value must be estimated.

The accompanying graph represents drainage or runoff coefficients where experience has indicated that lands protected by drainage ditches of the capacity indicated on the curve may be used for growing of row crops. Field crops, such as corn and grains, can be grown where protection, equivalent to a C curve, is secured. A lower capacity for ditches is sufficient to enable protection of hay or pasture crops. Grass will stand more frequent overflow for a longer time and a higher water table than many cultivated crops. I believe that the D curve could be used to provide adequate drainage for hay and pasture lands in situations where cultivated crops are not to be grown. There is a definite need for more study of successful drainage systems to determine proper drainage or runoff coefficients to use under hill conditions and for different types of land use.

Step 4. Establishing a hydraulic gradient for the proposed ditch.

The hydraulic gradient represents the surface of the water when flowing at the designed depth. Its slope is the slope used in Kutter's or Manning's formulas to determine the velocity. It is established by determining the elevation of "control" points along the ditch. Such control points include elevations of low fields to be drained, hydraulic gradient of ditches or streams entering a ditch, elevations of buildings, roads, and other property to be protected from overflow by the proposed drain. The elevation of control points is established by careful surveys and data are plotted on a profile. The drawing of a uniform gradient through a series of "control" points, which are often irregular along the profile, requires practice and experience to secure good results.

Step 5. Establishing minimum depth and side slopes of drain.

Generally the best ditch is the deepest section that can be constructed and maintained economically. The equipment available will influence the minimum depth. Where a power excavator is used, not less than a 4-ft minimum should be maintained for the outlet ditch even where farm drains and laterals are shallow V type drains. This may permit some extra depth for collection of silt before rehabilitation is necessary. Where construction is by tractor and grader, a 3-ft minimum for outlet ditches is permissible because such ditches have flat side slopes and may be maintained more readily. Where tile drainage is to be installed, the grade of the outlet ditch should be not less than 18 inches below the grade of the tile outlets. On ditches to serve as tile outlets it is desirable to maintain a 6-ft minimum depth where possible. The above statements apply to heavy and medium soils and do not apply where quicksand is encountered or where sandy, muck, or peat soils are involved. Such conditions require special study. Side slopes not steeper than the following are recommended: clay and heavy soils, 1½:1; and lighter soils, 2:1 to 3:1.

Step 6. Determining maximum allowable velocity based on soil type.

In some of the sandy soils a velocity of 2 to 2½ feet is not safe and will produce undesirable erosion unless special means are taken to protect banks. On clay and heavy soils a velocity of 4 to 5 feet is usually safe. This is a local problem which must be considered for each ditch.

Step 7. Determining the ditch size based on Kutter's or Manning's formulas.

The use of Kutter's and Manning's formulas is covered adequately in various texts on hydraulics and drainage and only the value of n needs to be considered. It is believed that the value $n = 0.035$ for medium-size ditches and a 5 to 10-ft bottom width may be generally used. For smaller ditches, a 4-ft bottom width or less, it is desirable to increase the value of n to 0.040. Large ditches and special conditions require individual consideration.

Step 8. Planning auxiliary structures, operations, and maintenance practices, including bridges, culverts, inlet structures, headwalls, and bank protection for open ditches.

Many structures built in drainage ditches have failed in the past because of inadequate design. Headwalls have often failed because the weir capacity was inadequate, wing walls were not large enough, or the foundation was not adequate. It is often possible to substitute sodded outlets and avoid costly structures to get the water from field to ditches. A pipe can often be used as an outlet for a tile drain and construction of a headwall thereby avoided.

It is desirable to vegetate ditches with grass or a low-growing type of vegetation to stabilize the banks and prevent the filling of the ditches through erosion or caving of the banks. Grasses will develop on some ditch banks naturally, especially where brush and woody vegetation is cut annually for the first few years. Under other conditions the planting of grass seed, or proper vegetation, together with application of fertilizers, is desirable to establish proper vegetative cover.

The leveling of spoil banks is being done more generally. When leveled, they may often be used for hay or other crops. Row crops are often grown on leveled spoil banks but their use should be limited to the slope away from the ditch. Many spoil banks can be planted with vegetation that will furnish cover or food for wildlife.

The importance of proper maintenance cannot be overstated. More ditches fail through neglect of maintenance than from any other cause. Brush and woody vegetation should be cut from the ditch annually. Where a good vegetative cover is established, brush cutting is often greatly reduced in amount. The pasturing of ditches to secure maintenance is receiving increasing recognition and in many places pasturing is a desirable practice. However, pasturing of ditches should be controlled. Hogs should be kept out at all times. It is often possible to excavate a small area adjacent to the ditches for hogs to wallow in and fence them out of ditches. All livestock should be kept out of ditches following thaws and heavy rains. Ditch banks should not be overgrazed. Sloping runways should be provided at intervals along the ditch to permit stock and cattle easy access without damaging the banks. These practices should be taken into account in planning a drainage system.

Step 9. Designing laterals and farm drains, including covered drains and open drains.

The design and installation of adequate farm drains are likewise of great importance. Many community or main drains have been installed that were not effective because farmers did not install the adequate farm drains to drain their fields. The V type field drain is coming into greater use for surface field drainage. Tile drains are particularly valuable to secure proper underdrainage. The value of tile drains is generally recognized by farmers and they will spend money for tile when income from land justifies such cost. The design of farm drains is covered in state and federal publications as well as textbooks on the subject.

In War and in Peace

The American Society of Agricultural Engineers and its membership occupy a rather enviable place in service to agriculture, both in war and in peace. It must be admitted, however, that it also implies responsibilities of vast proportions. From the beginning of the organization thirty-eight years ago, one of the cardinal principles motivating its activities has been efficient agricultural production. At times this principle has been challenged by those who feared farmers were becoming too efficient and the government set up regulations and various types of economic controls to slow down food and fiber production. The experiences in World War II, however, have amply demonstrated the manpower advantages of nations which have efficiency in agricultural production. Even under the handicaps imposed by the carry-over of the ideas of suppressed production, our nation, because of its liberal use of labor-saving equipment and the application of the best technological methods in growing crops, has been able to produce large volumes of needed farm products with limited labor.

Federal Agricultural Engineering Research

By Arthur W. Turner
FELLOW A.S.A.E.

IN THE USDA Bureau of Plant Industry, Soils, and Agricultural Engineering we have the following divisions devoted to agricultural-engineering research: Farm Structures and Rural Housing, Farm Power and Machinery, Mechanical Processing of Farm Products, and Rural Electrification. Much of the research conducted by these divisions is cooperative. For example, in our fertilizer-placement studies in the Division of Farm Power and Machinery, we cooperate with other divisions of the Bureau, with state agricultural experiment stations, and with the fertilizer and farm equipment industries. The objective of this work is to ascertain, by experimentation, where to place each kind of fertilizer with respect to the seed, seed piece, or plant of any particular crop. The proper location may vary depending on such factors as composition of the fertilizer, type and condition of soil, kind of crop, root characteristics, climate, moisture conditions, and so on. The most advantageous location of the fertilizer is of utmost importance to the farmer, and can be determined by the cooperation of several groups of agricultural specialists—engineers, soil scientists, agronomists and fertilizer chemists.

That is an example of what we call basic or fundamental research, and it is the responsibility of public service research agencies. Also, it defines the scope of our research, since in this case when the proper zones for fertilizer have been determined, it is the manufacturer's job to design or adapt machines to place the fertilizer in those zones.

The test of agricultural engineering research is its practical value to farmers. Will the results increase farm income and raise the standard of rural living? While they play an important part in any research program, unlike many other sciences the findings of agricultural-engineering research usually have to go through a process of manufacturing development, by a manufacturer before the farmer can derive the benefit from them. This is true whether the research calls for new practices, for new or improved machines, new materials, new types of structures, and so on. For that reason I want to emphasize that agricultural-engineering research, whether by state or federal agencies, should be conducted in close cooperation with the various related industries to the end that the results are made available to the farmer as quickly as possible.

Federal agencies, to a certain extent, help to coordinate and expand research work conducted by state agencies. As an illustration, I will take hay, a very important subject at the moment, and one on which considerable research is now under way.

First, let us take a look at the equipment produced by manufacturers of hay machinery. Under 1945 manufacturing quotas we will have roughly 100,000 mowers, 25,000 sulky rakes, 39,000 side-delivery rakes, 10,000 sweep rakes, 23,000 loaders, 6,000 stackers, 9,000 pickup balers, 3,000 stationary balers, 3,200 field choppers, 7,500 silo fillers (for ensiling grass)—all for harvesting hay.

Machines are being manufactured to produce the hay crop by (1) the old method of cutting, field curing, raking, and either stacking or mowing in the barn; (2) cutting, curing, loading, chopping, and blowing into the barn; (3) cutting, wilting, loading, chopping, and curing in the barn; (4) cutting, wilting, loading, and curing (as whole hay) in the barn; (5) cutting, field curing, and gathering with a pickup baler; (6) cutting, wilting, windrow baling with pickup baler, and curing in the barn; and (7) cutting, field chopping, and ensiling green. Here are seven ways to harvest hay, America's second largest acreage crop. Here also is to be found keen competition within companies as to practices and equipment to harvest this one crop. Here, too, valuable time of engineers, production men and sales organization personnel is employed in a competitive way to carry out the pet ideas of a few individuals or to satisfy the whims of certain localities. We need the results of research on which to determine the best method of producing quality hay under various conditions; that is, hay that will provide palatable feed and maximum, economical milk or meat production.

Two of the seven methods mentioned for producing hay include barn curing. These methods are new and much research is needed — research that is logically the job for public-service agencies. Here are some of the points brought out at the A.S.A.E.-sponsored barn hay curing conference last December, indicating the great need of research: (1) Standards for measuring and comparing research, (2) rate of air flow and resistance pressure for different crops, (3) bacteriological reactions (particularly molds), (4) effect of length of drying time on palatability, nutrition, etc., (5) density factors (growth, maturity, processing, depth of storing), (6) engineering economy of operating drying systems, (7) conditioning of over-dried or harsh, stiff hay, (8) comparison of field-dried hay with that prepared by other methods, (9) comparative acre yield and maturity studies, (10) nutritional studies, (11) system design for barn drying, (12) respirational loss and plant physiology of hay, (13) field management of hay making, (14) mechanical methods of handling hay in the mow, (15) quality factors (standards of measurement), (16) use of artificial heat, (17) humidity, heat and moisture balance studies, (18) over-all cost of barn drying as compared to other methods, (19) standard method of sampling hay.

I believe ours would be the logical federal agency to assume responsibility, in cooperation with all groups concerned, for sponsoring a complete research program on hay harvesting and storage. Such a program should include the engineering, agronomic, bacteriological and other phases, from the first field stages of harvesting the crop through to and including animal feeding studies. The first step would be to check what is already being done, then find the gaps in the program and proceed with obtaining the missing information, by the agencies best equipped to do the job. The cooperation of many experiment stations would be required to test the different practices under all kinds and conditions of climate, humidity, crop and soil; and all technical facilities, including personnel, should be utilized to carry on such a program most advantageously.

At the conclusion of the program, we should call a conference for the purpose of analyzing and summarizing all the data, and of setting up fundamental requirements covering harvest practices, storage conditions, etc. With these fundamental requirements established on the basis of sound research, the manufacturers could then apply the findings to the development of hay machinery, of storage structures, and of electric equipment essential in meeting the requirements of proven methods of harvesting, storing and feeding the hay crop.

Hay is just as big a subject for research study as the acreage it covers.

Federal and state agricultural experiment station research can in no sense be regarded as a substitute for, or in competition with, research done in the research laboratories of industry. The latter is essential if the new findings of fundamental science are to be translated most effectively into manufactured products.

Federal research, along with the research by state agencies, must be regarded as the principal source of that body of fundamental science which the industrial research laboratory will bring to practical and commercial fruition. The existing pressing demands upon applied science, due in large measure to the war, have served to show, in sharper focus, how the solution of problems of industrial development and production is often delayed by gaps in fundamental knowledge. In the solution of pressing war problems, often much time is lost in first having to resort to research for basic data needed. Even in normal times the industrial laboratory looks to a large extent to research for the fundamental facts it requires.

In carrying on the research work of the agriculturing-engineering divisions of our bureau, we do some designing and machine building. I will take our fertilizer-placement work as an example. Some 30 machines have been built. The testing with each crop is done in several places to establish the facts from which widely applicable recommendations can be made. To date 575 fertilizer-placement tests have been carried on in 25 states with 34 crops. A

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Ga., February, 1945.

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few of the long-time, average-yield increases per acre from proper placement over common practice are: Cotton, 253 lb; potatoes, 30 bu; snap beans, 653 lb, and tobacco, 156 lb. Probably the quickest response by manufacturers to the results of any one project was that of developing equipment to place fertilizer on the plow sole.

There are of course some crops of such small acreage that the potential volume of machine sales to take care of them is not sufficient to interest large manufacturers. Fiber flax of the Pacific Northwest is an example. In such cases we often cooperate with local manufacturers, both in procedures and equipment development, but never in producing equipment.

The illustrations I have used so far of research activities and needs refer only to the farm power and machinery division of our bureau. There is great need now for fundamental research in the field represented by our farm buildings and rural housing division. Such research is urgent in view of the great amount of farm construction that will undoubtedly be done when the war is over and materials and men are available. Expenditures for repairs, remodeling, and new farm buildings are, according to conservative estimates, likely to be in excess of a billion dollars a year. That rate of building, according to present predictions, may continue for 10 years, more than doubling our present farm building valuation. Farmers generally are in a good position financially for improving their buildings. Also, new plans are now under consideration for financing farm building improvements.

However, the mere expenditure of money will not produce farm buildings functionally better than those now in use. Most existing farm buildings are (1) wasteful of labor, (2) not adapted to maximum production by livestock or to best preservation of the quality of stored crops, (3) not built to meet desirable sanitary standards, and (4) not adequately protected against fire and wind hazards. To avoid these shortcomings, farmers, builders and manufacturers of building materials need a great deal of basic information about the best types of buildings, including animal-housing requirements, for use under different climatic conditions and for each type of farming. To meet this need will require the cooperation of all agencies interested in farm building research—the state agricultural experiment stations, the building material and equipment industry, and federal research agencies.

PUBLIC AGENCY RESEARCH FILLS GAPS IN KNOWLEDGE

Public agency research has the responsibility of filling the gaps in our knowledge of fundamental principles; we need to learn the optimum requirements for housing livestock and storing crops, including the proper space, temperatures, humidity, air supply and light for dairy cows, hogs, poultry, and other livestock. We need also to find out what losses in production or in quality of product result when optimum conditions are not provided. Closely allied with studies of such matters is investigation of ways and means for saving labor both in buildings and about the farmstead, which comes under the heading of time-and-motion studies. These things call for fundamental research that should be conducted in cooperation with other agricultural research specialists, namely, in animal industry, dairy industry, plant pathology, plant physiology, etc. When the results of such research have been obtained, then building materials and equipment interests may translate the findings into improved farm buildings.

As a stopgap—and the responsibility should be shared jointly by the state agricultural experiment stations and our farm building and rural housing division of the BPISAE — all readily available information relative to farm buildings should be assembled and made available to all interested groups. This may call for revision of most of the farm building bulletins now furnished by the colleges and the Department, or else the preparation of new bulletins to replace them. It also calls for revision of the farm building plan services to weed out plans no longer adequate and to bring others up to date. A good start on this part of the program has been made by the state agricultural experiment stations of the north central region, the station directors of that region having set up a coordinating committee on farm buildings to meet the increased demand for information that is now foreseen when the war is over. This committee has set up 13 subcommittees to prepare specific bulletins and revise the Midwest Farm Building Plan Service.

An acute situation exists as to farmhouses. In this case cooperation is desirable between certain divisions in the Bureau of Human Nutrition and Home Economics, the state agricultural colleges, and other groups interested in housing of farm people. The housing needs of the farm family are greater than those of urban dwellers, consequently special study is desirable if farm families are to live comfortably in houses that last an average of 65 years. Agricultural engineers are specially qualified to assume a large share of the responsibility for doing this job.

The farm building program just outlined will involve a tremendous amount of work and will require the joint efforts of all interested groups. The need is now much greater than we are prepared to meet.

The application of electricity to agriculture has progressed to the point where now 40 per cent of the farms of the United States are connected to "high lines". We have the assurance from electric utilities and the REA that this number will be doubled shortly after line-construction materials and appliances become available. Electricity has contributed much to farm living, but as yet little to farm income. Income-producing applications are greatly needed to help pay for the convenience of electricity and to obtain a sufficient farm load that will result in lower rates. The opportunity exists for developing a variety of uses, as, for example, hay curing, tobacco curing, quick freezing and refrigeration of perishable food products for market and home consumption, water supply for home and livestock, farm food processing, food storage and preservation, electrically operated conveyors and elevators, small automatic feed grinders, electric sorting and grading devices, plant disease and insect control, and many others. We plan to initiate research work in connection with some of the major subjects, and will expand it as rapidly as facilities permit.

The present division of mechanical processing of farm products in our bureau will undoubtedly expand into a rural industry division. We can and doubtless should initiate engineering studies in addition to present research on cotton, flax and sansevieria fibers. We might very well include creameries, cheese factories, community soybean crushing plants, tung nut crushing plants, elevators and feed mills, community canneries, locker storage plants, fruit and vegetable storage and packing centers, portable sawmills, and many others.

MOST AGRICULTURAL RESEARCH PROJECTS INVOLVE SOME ENGINEERING

The agricultural engineers of our bureau have responsibilities in addition to those of our own divisions, in connection with numerous research projects in other agricultural sciences. In fact, it is difficult to find any agricultural research project that does not involve more or less engineering. Some of this research is proceeding without engineering assistance. As a result, many findings may have to be revised. The following are examples which should include engineering studies: Field equipment for determining the desired soil tilth for various crops, soils and climatic conditions; spraying and dusting equipment in entomological investigations; buildings and electricity in nutritional studies of livestock and poultry; facilities for partial and complete farm processing of food and feed; building materials and utilities for farm homes; equipment for orchard cultivation; economical means of cleaning and sorting seeds; equipment for producing, transporting, and storing farm materials to be processed into industrial products (chemurgy).

Also, isolated agricultural engineering research will not in most cases be especially fruitful; our work must be fully cooperative with allied agricultural sciences. The valuable research on fertilizer placement is a good example; other examples are the work of the cotton ginning laboratory at Stoneville, Miss., the sweet potato station at Ellisville, Miss., the grain storage studies at Ames, Iowa, and Urbana, Ill., the tillage machinery laboratory at Auburn, Ala., the plant and pest disease equipment laboratory at Toledo, Ohio, the sugar beet production and potato storage work at Fort Collins, Colo., the flax fiber laboratory at Corvallis, Ore., and the sugar cane production work at Houma, La. However, even these cooperative research arrangements perhaps should be re-examined to see if all interested research groups are in consultation. As engineers we have an obligation to show *even greater* initiative for wider cooperation and better coordination in *agricultural* research.

To summarize the foregoing, federal agricultural engineering research responsibilities boil down to the following:

1 Initiate cooperation with other agricultural research groups in carrying out our projects.

2 Cooperate with other research groups in federal and state agricultural experiment stations in planning and conducting research programs. *(Continued on page 201)*

Extension Work in Farm Machinery

By J. B. Wilson

MEMBER A.S.A.E.

ANY extension program to be effective must be justified. The present justification is based on two premises: (1) that of immediate or wartime production, and (2) on a long-time basis which involves major adjustments on the farm.

Due to the loss of about 70,000 men from Alabama farms, there is a serious shortage of labor. This shortage though is based on the traditional method of production which emphasizes maximum hand labor. It is a natural result of cotton farming where labor for harvesting the crop must be kept busy with production. The loss of these men from the farm caused a marked increase in the demand for labor-saving equipment, and increased the desire for information about machinery and its operation. There was an educational advantage for the extension worker during the period of machinery rationing and this has created, generally, a desire on the part of farmers for more information about farm machinery and how best to use it.

Also, there has been a gradual decrease in the cotton acreage. Alabama now grows about $1\frac{1}{2}$ million acres of cotton. This acreage is producing nearly a million bales and still provides the main cash income. We then have left about eight million acres of crop land that must produce something else. The crops most feasible are feed, and it must be fed to livestock. Livestock farming is new in Alabama but some progress is being made and farmers know feed cannot be produced with plow stock and a weed hoe, and that more power and equipment must be used.

This feed production is complicated. There are several crops to be grown, any one of which is more complicated than that of growing cotton. Much educational work must be done here. Varieties, fertilizers, insecticides, must be studied and the equipment for producing and harvesting these crops is not generally understood by farmers.

Poor soils have always been a handicap in Alabama and the extension service has long worked on soil building. We know that erosion control must go along with soil building. Practically all of our soils have poor water-holding qualities. Therefore, the control of runoff water is a major job, and the first step in this is the terrace system. This calls for more power for construction and maintenance. The Nichols or channel type terrace is about to reach its twentieth birthday in Alabama. We were unable until recentiy to say much about one of the real virtues of this terrace, that is, its adaptability to power farming. It was designed with this in mind and is now being recognized by tractor farmers as the best adapted terrace where tractor equipment is being used.

Some progress is being made in soil building, but with the use of more power and with increased livestock production, erosion will be decreased, organic matter will be added, more sod crops grown, and more manure placed on the land.

There is another important factor in a farm machinery program that must be mentioned here and which has made it possible for farmers to use equipment. Manufacturers have discovered the problems in the South and have sent their designers down to work out machines for our conditions. Some progress has been made and more may be expected because they see the problem and must have heard about the demand for machinery that will work on terraced land.

To me, these things mean more production on more acres which will make for a better and more permanent agriculture.

There has, of course, been some educational work done on farm machinery during the past years, but our greatest effort has come recently. When machinery was put on the ration list everyone became interested. Allocations were made and quotas set up. The supply was too small to meet the actual need, to say nothing of the demand. This was our greatest opportunity to do something on repair and maintenance. Posters were sent out, titled "The Plowshare Is a Sword". Farm shops were dug out of the junk shed. A rush was put on the stock rooms for parts, and farmers were generally very vonscious of their "tools" and what they meant to them. The results were satisfactory.

We felt the need for a better organized educational program for farmers, and as a result we planned a serits of tractor care and maintenance schools. We knew that one specialist could never go to every county and hold a school. A proposal was made and approved that we call in the industry to assist with the program. It was suggested that we invite the branch managers of the farm equipment companies doing business in Alabama to come to Auburn for a conference.

The letters were written with fear and trembling because we doubted their interest. However, in the fall of 1943 at the date set they were all there, along with representatives of the major oil companies. An itinerary was worked out for the state, placing a representative of an oil company and a representative of a tractor company together, and by the use of moving pictures and lectures, the story was carried to every county. Reports show that approximately 30 per cent of all tractor owners and operators in the state attended.

This type of program was well received by county agents and they voted to repeat the program again this winter. This was done and the schools were completed last week. The best figures we can get indicate that better than 40 per cent of the owners and operators of tractors attended.

We are debating whether or not to continue these schools. If we do, prior to the dates for the schools, we will hold a 2 or 3-day conference at Auburn for the purpose of selecting the right kind of pictures and preparing the story for the farmer. We must minimize advertising and we must all speak the same language. There is no indicated problem here because company representatives have cooperated splendidly. The program, however, needs more correlation.

So much for the tractor schools.

I am not surprised at the fact, but I am surprised at the frankness of our county workers in stating that they themselves are not qualified to help farmers with their machinery problems. This has incited the proposal that we begin this year with schools for county workers only. It is felt that, with them alone in groups of 15 or 20, we can get down to basic study of what the job is and how to make the machines do it. As in the tractor schools, we expect the cooperation of the industry.

These schools are planned on the job basis and are built around the four main jobs on the farm, namely, soil preparation, planting, cultivation, harvesting.

Each school will be held at or near the time when the job is being done on the farm. For example, the soil preparation schools will be held in the spring prior to spring planting or in the summer prior to fall planting.

It is not expected that we will be able to conduct all the schools on all four jobs in the first year, but the objective will be to get around eventually to every worker with the full program.

Once these schools have been held it is expected that the county worker will be in position to conduct demonstrations and schools with his farmers and thereby build up his own and the farmers information to where they will do a better job of selection, care, and operation with their equipment.

The agricultural engineering extension specialist, of course, will be available to promote and assist with county programs.

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Georgia, February, 1944.

J. B. WILSON is extension agricultural engineer, Alabama Polytechnic Institute.

Federal Agricultural Engineering Research

(Continued from page 200)

3 Seek the cooperation of related industries in outlining research activities.

4 Promote interest and activity in time-and-motion studies in field, building and home operations.

5 Release results of fundamental research promptly.

6 Serve as a national clearing house of agricultural-engineering research.

Electronics in Postwar Agriculture

By R. J. Jackson

THIS paper will disappoint those who expect to find in it that electronics is used extensively in agriculture. Its purpose is to explain in simple terms the fundamentals of electronics and tell of some of its uses in other industries. Its future in agriculture will be the responsibility of the engineers of your profession and you will find our industry ready and willing to assist in any way.

In a sense, electronics isn't so new to farm families as most of them have radio receivers in their home, and a radio receiver is an electronic device. The science of electronics deals with the control of the flow of electrons which have been freed from the boundaries of conducting wires. We must first produce the electrons if we are going to control them; so let us examine how it is usually done.

All matter, whether it be soil, moisture, fertilizer or a cotton plant, can be resolved into 92 some odd chemicals, which constitute everything on this earth. Each of these 92 elements can be further broken down into fundamental particles of matter, one of which is the electron. Electrons are negatively charged and tend to move toward a point having a more positive potential. These electrons can be freed from their atoms in several ways, but the most common method is by the application of heat.

The heart of all electronics is the electronic tube, and it consists essentially of two electrodes, one of which is called the cathode and the other the anode. The cathode is heated by a filament to drive off electrons, and the anode is positively charged to collect them. We usually enclose these electrodes in a glass or metal envelope so that the air can be removed and special types of gases introduced, both of which offset the flow of electrons from cathode or anode. A third element is placed in one simple tube between the anode and cathode which we call a grid. By changing polarity of this element from positive to negative, the flow of electrons can be controlled. In this case, the tube acts as a relay or valve. The tube can also be used to amplify weak signals which allows them to be used to do real work.

The important advantage of the electronic tube is its speed of response. Electrons in space move at the rate of 167,000 miles per second and may reach the velocity of light, 186,000 miles per second. Here then is a tool—a relay, a detector amplifier which responds instantaneously to allow jobs to be done on the split second.

To be sure, that is a very brief picture of the fundamentals of an electronic tube and I hope I have succeeded in making it sound as simple as it is. It is our duty today to take some of the blue sky out of the subject of electronics and bring it back to earth. No matter how fantastic the electronic world of tomorrow may be, we have behind us fifteen years of genuine achievement in the electronic art, and by telling you about some of these I hope to stimulate your imagination. In so doing I will be paving the way for the future of electronics in agriculture.

There has been developed an electronic timer which allows photographs to be taken of things invisible to the naked eye, such as the finest details of air disturbance. The camera can even take a picture of a heat wave rising from the palm of one's hand, or capture a picture of a sound wave and its reflection.

An electronic control which automatically synchronizes a new type of shutter with the bursting of a flash bomb makes it possible to take night photographs of the ground in enough detail to permit the closest military study. This device weighs only 9 lb and operates on three billionths of a watt or about the equivalent of the energy spent when a human hair falls one-tenth inch.

There is an electronic device for detecting mercury vapor that is so sensitive that the vaporization of a single calomel pill, dropped into the firebox of a boiler, will touch it off. It will detect one part of mercury in 200 million parts of air.

Another electronic measuring device is the profile gage used for checking gear teeth. Variations can easily be read to indicate inaccuracies as small as 1/10,000 inch.

Induction and dielectric heating are electronic tools that have received much publicity of late and are being used for many purposes and processes.

Induction heating is of course used for treating metals. The charge is placed in or adjacent to an induction coil carrying a high-frequency alternating current. The magnetic field induces a current in the surface of the part and causes it to heat largely by resistance losses. The heat is generated in a surface layer, the depth determined by the frequency and the material treated.

Dielectric heating is used for treating non-metallic materials. The charge is placed between two plates or electrodes, thus forming a capacitor or condenser and voltage applied at frequency from one to 100 million cycles. Since it is well known that losses occur in even the best capacitors, power in the form of heat can be dissipated in high-loss dielectric material such as plywood, rubber, plastics, ceramics, food, etc. The advantage of the dielectric method is that in a uniform field heat is generated uniformly throughout a homogenous mass.

Electronic turbidity controls are available to safeguard the water supply of communities. Somewhat similar is the control of the chlorine content of a municipal water supply.

Some of the vital war plants are protected by electronic "fences". Phototubes are used which are operated by invisible or infrared light. Perhaps some day a device of this character can be provided economically to protect farm property or used in place of present boundary type fences.

Photoelectric equipment in a Michigan plant is sorting 80,000 lb of beans a day. Beans to be sorted are fed into a hopper beneath which is a drum. A suction arrangement through tiny apertures holds the beans around the drum circumference and the drum carries them around to the sorting eye. White beans are passed; discolored ones are rejected.

The electron miscrope will probably find wider use in agriculture in the immediate future. It reveals what the eye aided by the most powerful light microscope has hitherto been unable to see. It extends to a region ten times higher in magnification than can be reached by the best non-electronic miscrope. Who knows but what this device, or some further development of it, will some day reveal to us the mysteries of plant life, seed, germination, etc.

There is an electronic device known as thymotrol which takes alternating current, changes it to direct current and provides means for controlling the speed of a d-c motor over a wide range and holding any speed with extreme accuracy from zero to full load. Speed is controlled by a small radio type rheostat which in turn can be controlled by moisture, heat, light, etc. A very good application of this drive is the control of the flow of food through dehydrating processes.

I could go on at some length describing other present uses of electronics in other industries. As I promised, I have given very little that meets the subject of this paper, "Electronics in Postwar Agriculture". I would be a prophet indeed if I knew, but who is there to say that electronic instruments will not some day be used to measure soil acidity or alkalinity, or that moisture-content detectors and indicators will not tell us the moisture content of hay, lumber, dehydrated foods, etc. Sterilization of air, milk and meat and the curing of other foods may be accelerated or controlled by various radiations emanating from different kinds of light sources, particularly of the fluorescent nature, and certainly these tools are electronic devices.

In view of the tremendous amount of electronic promises of the future which are now rampant, it becomes essential to face certain facts. Electronic devices of today are expensive, and if present devices do the job satisfactorily, is it sound to propose the electronic device? Economics will decide which to use, as has always been the case, and to do otherwise would be fatal to electronics in your industry. Likewise, if electronics can do things better or with more precision, then we may begin weighing the extra cost against the better performance obtained.

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Ga., February, 1945.

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Durability of Redwood Boards

By L. W. Neubauer
MEMBER A.S.A.E.

THE study of weathering and decay resistance of redwood boards, which is the subject of this paper, was undertaken as a part of a broader investigation of durability of boards, stakes, and posts at the University of California at Davis. Redwood lumber is particularly important in this region, because of its enduring qualities and availability. While it is of less concern in the northern and eastern sections of the country, its utility is recognized nationally, and its use is constantly growing.

A set of 1x12x48-in redwood boards of various grades was placed on test at Davis and observed through a period of 12 years, until it was necessary to terminate the experiment. Each board was set on end 24 in into loamy soil in a natural condition, with no preservative treatment. During the first three summers the specimens were watered at intervals, to accelerate decay and termite action. Subterranean termites are very common in this section, as well as in most other western and southern areas. They are less numerous in northern regions, but have been found in nearly all states.

Included in the set were 8 grades of redwood, and one each of Douglas fir and white fir. Similar sets of specimens were also placed at four other locations in California, although they were not tested in the same way.

The first failure at Davis occurred in three years, when the Douglas fir board broke. In four years the white fir broke. Both were badly decayed.

All redwood boards endured for the full 12 years, but showed various effects from termites and weathering. When they were removed, observations were made in order to rate them according to appearance. Then each was sawn longitudinally into 1x1-in strips, and cut laterally into 3 pieces, each 1x1x12 in, for comparing top, middle, and bottom sections. Each piece was tested for ultimate flexural strength in a lever type beam-testing machine. Thus a numerical comparison was made of various grades of boards, as well as for the three longitudinal positions. The accompanying tabulation shows this relation.

These data indicate that strength and appearance are not synonymous. Light grades generally showed the best appearance at the conclusion of the test, while greatest strength was exhibited by the heavy and clear grades. Sap wood was relatively weak in all cases. Number 3 grade heavy was strongest, and number 3 light was weakest, the ratio being nearly two to one. Samples were not sufficiently numerous to make the results conclusive, but they are indicative of what may be expected.

The strength of each grade has been plotted vertically to form the accompanying bar graph, showing visually the relative value of each specimen after the 12-year exposure. The superiority of the heavy samples, designated A and B, is already evident. Differentials between the other values are not sufficient to be very significant. It is obvious that none of these redwood boards was weakened seriously by the period of exposure.

A comparison among the top, middle, and bottom sections is also shown, the latter being definitely inferior to the others. Termites and fungi apparently had very little effect above the ground and at the ground line on the middle sections; weakness usually developed a few inches below the ground surface and on the lower section. The upper half of each specimen seemed to suffer no appreciable weakening.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

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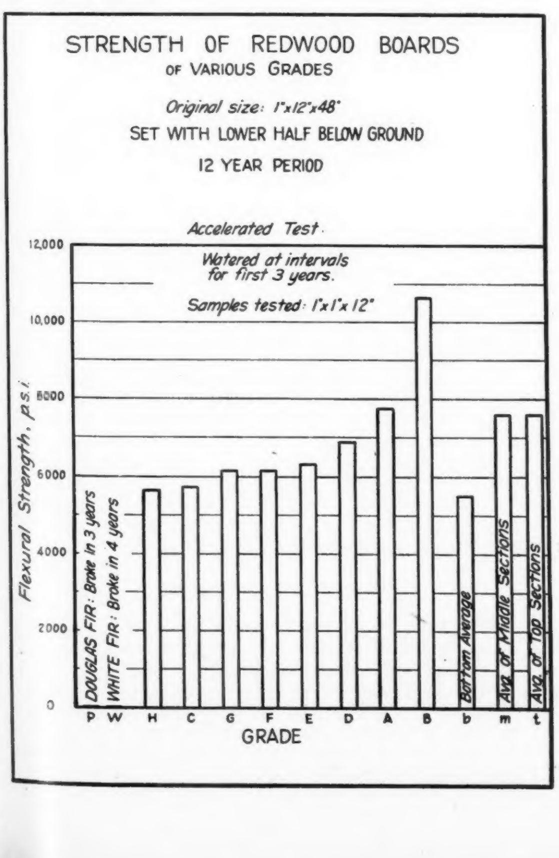

REDWOOD DURABILITY

Spec.	Wood	Grade	Condition Top	Condition Bottom	Weak section	Average strength psi	Rating Appear.	Rating Str.
A	Rw	Clear, heavy	WSC	tC	B	7,770	4	2
B	"	No. 3 heavy	WSC	TT	B	10,640	5	1
C	"	Clear, sap, heavy	WSC	ST	B	5,760	6	7
D	"	clear, extra light	W	Ft	B	6,870	1	3
F	"	sap, light	W	TT	B	6,330	2	4
F	"	construction	S	T	M	6,150	8	5
G	"	heart common, light	W	T	B	6,150	3	6
H	"	No. 3 light	WC	T	B	5,650	7	8
P	D.F.	Douglas fir	Broke in 3 years			0		10
W	W.F.	White fir	Broke in 4 years			0		9

KEY:
Rw=redwood
D.F.=Douglas fir
W.F.=white fir
W=weathered
S=split
C=cracks
wsc=small amount
t=trace of termites
T=some termites
TT=many termites
F=fair condition
B=bottom
M=middle

Engineers of Tomorrow

THE changes we engineers have fostered—to create this fast-shifting world of new tools, gadgets, methods—to put to use the great forces of steam, electricity, chemistry—have been made against a background of a slower-changing human nature, ill adapted in its fundamental characteristics to such rapid change in its environment. These changes have value only in so far as they improve life for human beings. Our civilization can advance only as the adjustments in human relations keep pace with changes in our environment, or at least do not lag too far behind them. The heritage of freedom Americans enjoy, which has permitted our profession to make its finest achievements and which we depend on for future progress, cannot be taken for granted—else we shall lose it.

As the horizon widens, as new frontiers open, what engineering students, when engineers, will do in the postwar world seems to involve far greater opportunities, far greater responsibilities than ever before. The content and methods and reach of engineering education will inevitably change accordingly. As engineering education keeps pace with expanding opportunities for engineers and changing requirements of society, so will our profession continue to serve its day and generation with increasing efficiency and with ever-widening fulfillment of its charter of service. — R. M. Gates in "Mechanical Engineering" for January, 1945.

Some Early A.S.A.E. History

By E. W. Hamilton
LIFE MEMBER A.S.A.E.

IN THE waning years of the nineteenth century and in the very tender years of the twentieth, there was dropped on the doorsteps of several of our land-grant colleges a new kind of infant course to be added to the regular agricultural college curriculums. It is a disputed question as to just which college received the first call from this educational stork; in fact, some of them are still out behind the barn arguing the matter.

These infants were fathered by the agronomy departments of several of the land-grant colleges, and only the Lord knows who the mothers were. It doesn't matter.

No one seemed to know just how those infants should be dressed, with what or how often they should be nursed, and how they could be amused.

Nursemaids were hired who were called "agricultural engineers" and what a time those nursemaids had! In most cases the nurseries were small and poorly equipped, the equipment consisting largely of some forges, a few hammers, a post drill perhaps, and an anvil or two.

There was no definite or established feeding formula. The infants yelled lustily for nourishment and the nursemaids were at their wits ends to keep their many wants appeased.

In the winter of 1906 three of those nursemaids met in desperation at Urbana, Illinois, to discuss the situation and to devise ways and means by which the infants could be kept alive and made to grow and develop. These men were J. B. Davidson of Ames, Iowa, C. A. Ocock of Madison, Wisconsin, and F. R. Crane of Urbana.

I have never seen a transcript of what actually transpired at that meeting, but I do know that a meeting was suggested to be held at Madison, Wisconsin, in December of the following year to which all interested in agricultural engineering were to be invited. That was the beginning of the American Society of Agricultural Engineers.

At 8:30 a.m., December 27, 1907, in Room 106, Agricultural Engineering Hall, University of Wisconsin, the first meeting of the A.S.A.E. was called to order. At that time it was not known as the American Society of Agricultural Engineers. It was born but it had not yet been named or christened, and thereby hangs a tale.

There was considerable discussion among that organization group as to just what to name it. The words "American", "engineers", and "society" were pretty unanimously agreed upon, but when it came to "agricultural", that proved somewhat of a sticker. H. W. Riley of Ithaca, New York, insisted that the word "rural" should be used, and, as the verbal battle raged over the name, Riley stuck by his guns and defied all opposition. It looked for a time as if the Society would be dashed to pieces on the rock of argument over one word in a name.

There lived at that time in Madison, Wisconsin, a gentleman by the name of Bascom B. Clarke, who owned and edited a magazine known as the "American Thresherman". Both Clarke and his paper have long since passed to the Great Beyond. Clarke being an outsider was called in to arbitrate the dispute. He insisted that the name should be the American Society of Agricultural Engineers instead of "rural engineers" as Professor Riley would have it.

Riley went down for the count, but soon came up smiling.

I cannot let the opportunity pass without expressing wonder at and admiration for the knowledge and foresight which Professor Riley evidenced in the paper which he read at that first meeting under the title, "The Courses in Agricultural Engineering That Should Be Offered." Despite the fact that in 1907 there were really no tractors, no small combines, no automobiles, no radios, no airplanes, no complement of tractor-drawn or driven equipment, a farm transportation system that was scarcely suited to a horse and buggy, no "plowman's folly"—despite the absence of all these things, Professor Riley laid down a program so sane, constructive and comprehensive that agricultural engineering is still a long way from catching up with what he visioned at that time. I am not for a moment inferring that the Society has not progressed nor that it has not kept up with the times. I merely wish to call your attention to the fact that it got away to a head start because of the foresight of certain individuals.

Less than 20 people made up that first group but the work done at that first meeting will compare favorably with some of our best meetings today. Men like J. B. Davidson, H. W. Riley, P. S. Rose, H. M. Bainer, L. W. Chase, E. A. White, F. R. Crane and others recognized the infant which had been dropped on the doorsteps of their respective colleges for what it was, and they were determined that it must be nursed and guided in order that it might take its place in our national economy. Special credit must be given to the judgment and guidance of Dr. J. B. Davidson in those early years of the Society. Time and again he aided the infant organization when the going was rough and enthusiasm ran low.

The membership dues were set at $2.00, and the treasurer in those first years didn't have to worry about Society money, because he didn't have any. I know because I was treasurer during the third year of the Society's existence.

The second meeting was held at Urbana, Illinois, and the third at Ames, Iowa. More was accomplished through the informal conversations between those in attendance than from the meeting programs. The agricultural engineer was just beginning to get his feet in the door of our agricultural economy. The gas tractor was edging into the farm power field. In 1910 I arranged to have a number of the then existent agricultural engineers come to Canada to act as judges in a motor contest which was being held at Winnipeg, Manitoba, and which was participated in by practically every gas tractor made at that time. Tractors were there from the United States, Canada, England, France, Germany, and Italy. What these agricultural engineers saw and learned at that contest would make a story in itself. It did much for future tractor development.

The meeting groups were small in those first years and nearly everyone in attendance had some part in the program.

Industry scarcely knew that such a society existed and the U. S. Department of Agriculture regarded it with a somewhat weather eye. It is significant to note that two of our larger farm equipment concerns, who scarcely noticed the Society in its first years, have since given us two and three fine presidents, respectively.

There is one gentleman whose name I would like to mention in connection with those early years of the Society, and that is J. B. Bartholomew, then president of the now defunct Avery Company of Peoria, Illinois. J. B., as we called him, was an industrialist who came up the hard way. Somehow he saw in the A.S.A.E. something that was of value to industry and he gave it his moral and financial support. At one time I am sure the Society would have gone on the rocks financially if Mr. Bartholomew had not come forward with his personal check for a very substantial sum. Mr. Bartholomew died several years ago but he retained his interest in the Society until the last.

All credit must be given to those men who stood by the Society in its early years. It took courage and vision to dig money out of their own pockets to travel long distances and pay expenses to attend a meeting of only a mere handful of kindred spirits. That thought came to me as I attended the 1943 fall meeting of the Society in Chicago where more than 500 registered.

An excerpt from an address before the Southwest Section of the American Society of Agricultural Engineers at Dallas, Texas, March, 1944.

E. W. HAMILTON is engaged in product development and application research for the tractor division of Allis-Chalmers Mfg. Co.

Toward Larger Units

UNDOUBTEDLY the trend is toward larger farm units. That means the use of tractors, tractor-mounted equipment, combines, etc. It seems that agricultural engineers can be of most help to agriculture by developing equipment and methods to promote this trend, since the only way the farmer can have the more abundant life is to have an income large enough to permit purchase of a better home and home equipment. The gross income from small farm units is too low to allow this.

"Drainage and Irrigation Recommendations"

The drainage and irrigation recommendations drafted by a group of members of the American Society of Agricultural Engineers, representing its Soil and Water Division, at a meeting in Chicago last December, and published on pages 120 and 124 of AGRICULTURAL ENGINEERING for March, have elicited comments and suggestions from several agricultural engineers in the field of soil and water conservation. Excerpts from statements by these engineers follow, and, it should be pointed out, these comments were written before publication of the excellent statement on U.S.D.A. water policy by Secretary Wickard in our April issue. — EDITOR

THE following comments are made by number concerning each of the five paragraphs in the proposed recommendations on drainage and irrigation:

1 It would seem better to make the request for a statement of the nature, scope, authority, responsibility, and *objectives* in connection with water problems, from the secretary of each of the departments of government concerned, namely, Department of Agriculture, Department of the Interior, Department of Commerce, and Department of War.

In the Department of Agriculture, the Bureau of Plant Industry, Soils and Agricultural Engineering, the Soil Conservation Service, the Forest Service, the Bureau of Agricultural Economics, and the Farm Security Administration are all concerned with water problems.

In the Department of the Interior, not only the Bureau of Reclamation is concerned, but the Geological Survey and the Indian Service are also vitally concerned with water-control problems.

It may not be equally apparent that the Department of Commerce should be included, although certainly the Weather Bureau is interested in water problems.

A joint statement from these several departments may be desirable, but certainly it will require much more effort to obtain a joint statement than to obtain a statement by each secretary, restricted to the work of his own department. Coordination of objectives and procedures of the work in the three major departments might be attempted after the statement is completed by the secretaries of the departments.

2 It is doubtful, in my opinion, that western states can centralize all responsibilities in connection with water problems in one office to act as a clearing agency for all state organizations concerned. This opinion is based on the fact that western state engineers have police responsibilities with respect to the distribution of water to irrigation companies and others entitled to its use. Development of new irrigation and drainage enterprises, attack of research problems concerning irrigation and drainage, and educational activities in the field of irrigation and drainage seem to require different offices within each state. For paragraph 2, therefore, I would recommend the following:

"This group believes that there is need for each state to coordinate its activities in connection with water problems and in the development of irrigation and drainage projects, and that special effort should be made by the legislature and the governor in each state to avoid unnecessary duplication or conflict of activities by different groups or departments concerned with water problems."

3 This proposal is considered satisfactory, with the addition of the following clause to the last sentence: "and the adequacy of the irrigation water supply for projects in the 17 western states."

4 This proposal is considered satisfactory with minor modifications as follows: In paragraph 4(a) add the words "or water supplies for irrigation" after the words "existing facilities." Substitute the words "and increased efficiencies are needed" for the words "is needed" in paragraph 4(b). In paragraph 4(d) add the words "water supplies adequate" after the word "irrigation."

5 This proposal is considered satisfactory, with the addition of the words "Fluid Mechanics" before the word "Hydrology."

O. W. ISRAELSEN
Research professor of irrigation and drainage
Utah State Agricultural College

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In general these recommendations are very good, and should be issued in final form and distributed through the proper channels to those places where they will be of interest and possibly be heeded. I have the following suggestions to make:

In paragraph 1, mention is made of the land-use coordinator of the Department of Agriculture. I am wondering if this should not also include the director of water utilization of the WFA, in that such a division has been designated by the administrator.

Paragraph 4(a) indicates that the order of priority should apply to drainage and irrigation work for "projects in good condition so far as main ditches or canals are concerned but where additional farm facilities or improvement of existing facilities are needed to increase production." I believe the ideas are clear enough to most of us as to what is meant by this statement, but I am wondering if the words "main ditches or canals" should not be replaced with the words "the main works." This would tend to broaden the meaning by including such items as pumping plants, diversion dams, headworks, and major structures like siphons and flumes, in addition to the stated main ditches or canals.

Paragraph 4(d) indicates that the priority should apply to drainage and irrigation work for "new projects where the land is suitable for drainage or irrigation and the cost of development will be low." I am wondering if the Chicago discussion brought out that the low-cost projects should be the only ones considered for new development. Would it not be better to state that "the cost of development will be economically feasible"?

The general theme of the recommendations is very good, and I would like to see the A.S.A.E. submit them to those agencies or individuals who are interested in water programs.

HOWARD F. MCCOLLY
Chief water facilities engineer
Farm Security Administration, USDA

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I have one comment to make regarding the proposed courses in paragraph 5. If only one geology course is taught, it should be physical rather than historical or some other phase of geology.

CLYDE L. ANDERSON
Agricultural engineer
Soil Conservation Service, USDA

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I am in accord with these recommendations. However, I believe you mean to set up the priority under paragraph 4 just for the war period; the results of investigations under paragraph 3 will set priorities after the war. It may be new construction or broad-scale rehabilitation.

A. CARNES
Chief, regional engineering division,
Soil Conservation Service, USDA

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I have studied these recommendations and can concur with them.

Under paragraph 4, there is a question of interpretation that might require some explanation. It is pointed out that the "A.S.A.E. should recommend that feasible drainage and irrigation projects . . . . as food production areas . . . ." This statement could be interpreted to minimize the importance of drainage in irrigated areas. However, it could also be interpreted to include the irrigated locations as an important food production area and satisfactorily care for it.

Regarding paragraph 5, I have been visiting the several colleges in our region and discussing college curriculums for agricultural engineers. I have included all the items that your group listed with the addition of an advanced course in irrigation and concrete structures. Each of the department heads with whom I discussed these changes was very much interested in the possibility of adding soil conservation options to their courses.

KARL O. KOHLER, JR.
Chief, regional engineering division,
Soil Conservation Service, USDA

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Had there been a group of western men at Chicago when the recommendations were drafted, I do not think they would have been much different. I for one can endorse all of them, but paragraphs 1 and 3 in particular.

I have serious doubt about getting anywhere on paragraph 1, but it will do no harm to let people know how we are thinking. Each one of the federal agencies is very jealous of what it believes to be its field, and there is a tremendous amount of duplication and no consideration whatever of work done by other agencies. We know this all too well in California in the Central Valley and the All-American Canal projects. The Bureau of Reclamation and the Army Engineers do not seem to know that each other exists, let alone such state organizations as our Department of Public Works or the University of California.

Paragraph 3 is very timely. There are so many wild schemes to develop irrigation in the West as to make one dizzy. The Bureau of Reclamation is discussing widely the development of five million new acres of irrigated land in California and 20 million acres in the western United States. We have only about four million now irrigated in California and about 20 million in the United States. These proposals would double the area now irrigated. We have already used up probably 75 to 80 per cent of the land that is fit

to irrigate or that can be irrigated with any remote relation to economics. Some of our own state politicians who should know better, are talking about one million acres of new land to be irrigated from the Colorado for soldier settlement after the war. There isn't anything like a million acres of new land that is suitable for irrigation from the Colorado in California.

The Imperial East Mesa contains approximately 200,000 acres of public domain. The Bureau of Reclamation already has the canals constructed for its irrigation. A detailed soil survey of the area recently completed by the University shows a maximum of 40,000 acres suitable for irrigation and that suited only to highly specialized crops such as grapefruit, winter peas, winter tomatoes, and a few such crops. I cite this local instance only by way of the need for sound planning on a "long-time program on needs for food production."

I have made myself very unpopular with certain promoters, as being unpatriotic, lacking in vision, interfering with postwar readjustments, etc., but I can't help it. That is the way I feel. I am not opposed to any development that has any economic justification, but most of these postwar schemes promoted by federal agencies do not come in that class. I heard this expression the other day in a discussion on the extravagant use of public funds: "We do not lose our liberties, we give them away." That seems to sum up the condition in which we are going to find ourselves if we continue to ask the federal government to develop a lot of unsound projects for us.

WALTER W. WEIR

Drainage engineer, division of soils
University of California

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I believe the courses of action recommended are desirable and worthy of favorable consideration by the Society. I am especially interested in the recommendation to the Committee on Curriculums, relative to the need for fundamental engineering courses in the agricultural engineering curriculums.

In my opinion, agricultural engineering graduates must be thoroughly familiar with the basic principles of engineering, to be capable of effectively applying those principles to the needs of agriculture. Graduates who have only partial training in both engineering and agriculture will find, upon leaving college, that they can not compete satisfactorily with well-trained students in either field. Excessive time spent in relatively simple shop courses does not contribute materially toward an engineering education. Similar shop work can be obtained in many high schools.

In my experience, I have found practical justification for only two "ag" courses—farm crops and soils. Although graduated from a college having an agricultural-engineering curriculum accredited by E.C.P.D., I have had to dig out for myself fundamental engineering information that could be included in the regular curriculum. I would suggest that the agricultural-engineering curriculum contain a maximum of eight to ten semester hours in the school of agriculture. My observation of other kinds of engineers, engaged in agricultural engineering assignments, has been that the quality of their work is equal to or better than that of the average agricultural engineer.

I note in Dr. J. B. Davidson's article in AGRICULTURAL ENGINEERING for December, 1944, that "Agricultural engineering is exacting and difficult." Considering this fact, it is imperative that students be given adequate training for the work they will undertake. When the majority of agricultural engineers can perform as *engineers,* quite probably the question, "What is Agricultural Engineering?" will not be asked so often.

JAMES P. SPROUL

Work Unit Conservationist
Soil Conservation Service, USDA

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The group certainly has done a grand job in drafting these recommendations. The stress laid on promotion of drainage projects is most important. However, I wonder if there should not be added some recommendation, on the part of the A.S.A.E., that some extensive research program covering drainage problems be gotten under way in certain areas. Here in the Southeast there is a growing demand for drainage work, but few engineers feel that they have an adequate knowledge of the drainage capabilities, i.e., permeabilities and reaction to drainage of the soils in question. A study of these factors is now being proposed in the Soil Conservation Service (Region II). Such studies might well be carried out in other areas.

In making recommendations to the A.S.A.E. Committee on Curriculums, one might suggest the addition of Soil Chemistry and Physics. I believe such a course gives a very firm understanding of the chemical and physical relationships within the soil, in preparation for later work in hydrology and soil mechanics.

T. W. EDMINSTER

Project Supervisor (Research).
Soil Conservation Service, USDA

NEWS SECTION

A.S.A.E. Elects Claude R. Wickard an Honorary Member

CLAUDE R. WICKARD
Secretary of Agriculture

THE Honorable Claude R. Wickard, United States Secretary of Agriculture, has long demonstrated an active interest in the application of engineering in agriculture. Long before he went to Washington to take a top appointment in the Department of Agriculture, even on his own farms in Indiana, he cooperated with the agricultural engineers of Purdue University in making practical application of engineering principles in the solution of his farm problems. Both in personal management of his farms and in his official capacity in the Department of Agriculture, he has not only shown a genuine interest in but also a true understanding of the value and need for basic engineering and scientific facts in all aspects of farm production. As Secretary of Agriculture, he has fostered research in all phases of agricultural engineering, as well as other agricultural sciences, and has vigorously supported the dissemination of engineering and scientific information to the agricultural industry through various Department channels. He has attended such meetings of the Washington Section of the A.S.A.E. as the demands upon his time have permitted, and his excellent address on the water policy of the USDA published in the April issue of this journal was prepared with great care especially for presentation before one of the regular meetings of the Section.

It is said also that Mr. Wickard has manifested particular concern with respect to activities involving agricultural engineering in the Department and has personally used his influence in backing a "resurrection," as one A.S.A.E. member put it, of federal agricultural engineering research. In fact, he is reported to have asked one society member at a Washington Section meeting if he did not think he was qualified for membership in the Society.

In view of Mr. Wickard's genuine interest in agricultural engineering and his fine support of agricultural engineering activities in the Department of Agriculture, which are not generally known, the Council of the American Society of Agricultural Engineers has elected him an Honorary Member of the Society, and Mr. Wickard has graciously accepted.

1945 A.S.A.E. Annual Dinner

IN connection with meetings of its Council and Cabinet, to give necessary attention to the business affairs of the organization, the 1945 Annual Dinner of the American Society of Agricultural Engineers will be held at the Stevens Hotel, Chicago, at 6:00 p.m. on Tuesday, June 5th. The Chicago Section of the Society will play the role of host at the dinner. In addition to members of the Council and Cabinet, it is expected that attendance at the dinner will consist largely of members residing within the area of the Chicago Section.

The principal features of the program for the dinner will include the award of the John Deere and *(Continued on page 210)*

1945 A.S.A.E. Annual Dinner

(Continued from page 208)

the Cyrus Hall McCormick gold medals, the recipients of which were chosen by the Jury of Awards last December; the initial A.S.A.E. Paper Awards, established by the Society last year; the annual address of the Society President, R. H. Driftmier, head of the agricultural engineering department, University of Georgia, and an address on agricultural engineering in Great Britain by S. J. Wright, also a member of the Society and a director of the National Institute of Agricultural Engineering of the British Ministry of Agriculture and Fisheries. The program will be concluded with the inauguration of the new President of the Society, J. D. Long, director of research of the Douglas Fir Plywood Association, who will take office immediately following the dinner.

Reservations for the A.S.A.E. dinner may be made direct with Society headquarters at St. Joseph, Michigan, and should be accompanied with a remittance covering the price of the dinner at $4.00 per plate. Reservations will be received as long as they do not exceed the seating capacity of the room reserved for the dinner or are not in excess of the number allowed by regulations established by the War Committee on Conventions for persons attending the dinner outside of the Chicago area.

Chicago Section to Feature Farm Refrigeration

THE Chicago Section of the American Society of Agricultural Engineers has timed its next meeting to coincide with meetings of the Council and Cabinet and annual dinner of the Society at Chicago on Tuesday, June 5th. The subject for discussion at the Section meeting is "Engineering Farm Refrigeration," and the session will be held in the North Assembly Room at the Stevens Hotel, Chicago, beginning at 2:00 p. m.

The principal speaker on this program will be J. P. Schaenzer, acting head of the special problems section, technical standards division, Rural Electrification Administration, who has been directing special studies to determine functional specification for farm refrigeration. The program is being arranged to give particular attention to refrigeration requirements of milk and other dairy products and for the storage of frozen foods. The panel of experts for the discussion period include, in addition to Mr. Schaenzer, George H. Foster of Purdue University, Dr. Frank Gougler of the Illinois Agricultural Association, E. W. Lehmann of the University of Illinois, Dale J. McGinnis of J. G. Lesser Co., Inc., E. H. Parfitt of the Evaporated Milk Association, Ruth Whiting of the International Harvester Co., D. E. Wiant of Michigan State College, and M. L. Wilson of Babson Bros. Mfg. Co. Also those attending the session will be invited to take part in the discussion.

A. W. Farrall to Michigan

ARTHUR W. FARRALL, for twelve years a member of the research staff — the greater part of that time as director of research — of the Creamery Package Mfg. Co., and prior to this connection a member of the agricultural engineering staff of the California Agricultural Experiment Station, has been appointed professor and head of the agricultural engineering department of Michigan State College, and will take up his duties at East Lansing about June 15. He will succeed Dr. Eugene G. McKibben, head of the department for the past two years, who has resigned to take an agricultural-engineering research position in Hawaii.

Mr. Farrall is an agricultural engineering graduate of the University of Nebraska, holding both B.S. and M.S. degrees from that institution. Following graduation he became instructor in dairy engineering at the University of California, and in 1929 resigned to become research and development engineer and director of the research laboratory of the Douthitt Engineering Company of Chicago, specializing in milk plant and spray drying equipment design. He joined the Creamery Package Mfg. Co. as research engineer in 1932.

E. G. McKibben to Hawaii

DR. EUGENE G. McKIBBEN, for the past two years professor and head of the agricultural engineering department of Michigan State College, resigned recently to accept appointment as agricultural engineer for the Pineapple Research Institute of Hawaii which is affiliated with the University of Hawaii in Honolulu. Dr. McKibben's new work will be entirely in the field of research and will deal with the engineering phases of pineapple production from seedbed preparation to delivery of the product to the cannery.

It will also be of interest to agricultural engineers to learn that Dr. E. C. Auchter, formerly administrator, Agricultural Research Administration, U. S. Department of Agriculture, became director of the Pineapple Research Institute last February.

Washington Section Activities

THE program of the Washington (D.C.) Section of the American Society of Agricultural Engineers, at its regular monthly meeting April 5th, featured a talk by Ladd Haystead, editor of the "farm column" of Fortune magazine. Mr. Haystead presented an interesting and informative picture on the outlook for farm machinery and general farm efficiency in the postwar era; he gave special emphasis to the fact that machinery and improved methods will have an important place on the smaller farm units and in part-time farming operations as well as on the larger farms.

Both Secretary of Agriculture Claude R. Wickard and OPA Administrator Chester Bowles attended the meeting and spoke extemporaneously. The essence of Mr. Bowles' remarks was that the fear prevailing in some quarters that improved efficiency and use of machinery cause unemployment is unfounded and that such an attitude is unfortunate. He gave it as his opinion that the solution of postwar problems both in agriculture and in other lines of endeavor lie in the direction of increased production. Secretary Wickard in his remarks pointed out that farmers are ready and willing to attain even higher levels of production, but emphasized that prosperity in agriculture is definitely dependent on full employment in industry. A total of 64 A.S.A.E. members and visitors were present at the meeting.

The program of the Section's May 4th meeting featured the subject of rural electrification. The speaker at this meeting was Frank E. Watts, director of the rural electric information exchange sponsored by "Farm Journal," whose talk emphasized the social and economic approach to the extension of farm electrification.

A tour of the Beltsville Research Center of the U. S. Department of Agriculture at Beltsville, Md., is scheduled for May 21st, for the special benefit of the members of the Section.

E. W. Hamilton Made Life Member

IN recognition of outstanding service to the organization and the profession it represents, dating back to its very earliest history, the American Society of Agricultural Engineers, by unanimous vote of its Council last month, has designated E. W. Hamilton of the Allis-Chalmers organization a Life Member of the Society.

Mr. Hamilton took an active part in the affairs of the Society in its early years, serving as treasurer of the organization during the third year of its existence. Incidentally, it was largely through his efforts as treasurer that a leading figure of those days in the farm equipment industry, and later an Honorary Member of the Society, gave his personal check for a substantial sum which carried the organization through some stormy economic waters in its tender years. On another page of this issue Mr. Hamilton turns back the pages of history to an interesting chapter on A.S.A.E.

Mr. Hamilton and his fine missionary work in behalf of agricultural engineering are well known to most members of A.S.A.E. on the agricultural engineers on the staffs of the land-grant colleges and universities, as well as by a large number of members in the farm equipment industry. In the election of Mr. Hamilton as a Life Member, the Society recognizes that it is honored to have in its ranks a member whose loyalty and service have helped so much in gaining a wider recognition of the organization and the profession which are so important, especially in its earlier years. In his acceptance of election to Life Membership, Mr. Hamilton wrote: "From swaddling clothes in 1908 to a well-ordered, smooth-functioning, full-grown organization in 1945, whose opinion is sought for and respected by every branch of agricultural science is no mean achievement. It is evidence that its conception was right and that those who guided its destinies through the growing years were men of vision and sound judgment in the practical application of engineering to agriculture.

For several years Mr. Hamilton has been engaged in product development research for the tractor division of the Allis-Chalmers Mfg. Co.

H. M. Bainer Elected a Life Member

LAST month the Council of the Society of Agricultural Engineers elected H. M. Bainer, one of the original charter members of the Society, to Life Membership.

H. M. Bainer, father of Roy Bainer, a member of the agricultural engineering staff of the University of California, was in charge of farm mechanics work at the Colorado Agricultural College in 1907 and attended the organization meeting of A.S.A.E. at Madison, Wis., in December of that year, and accordingly became one of the charter members of the new organization. For a number of years Mr. Bainer has been general agricultural agent of the Atchison, Topeka, and Santa Fe Railway System, with headquarters at Amarillo, Texas. While his work has not involved agricultural engineering to any appreciable extent, nevertheless he has been a true friend of the Society and of the profession, and has maintained a keen interest in the various phases of engineering as applied in agriculture. Because of this and because of his early

service to the Society as a charter member, members of the Society will applaud the action of the Council and welcome Mr. Bainer as an active member again of their organization.

Lincoln Agricultural Award Program

AN AWARD and scholarship program to encourage the scientific application of arc welding in farm operation and maintenance has been announced by the James F. Lincoln Arc Welding Foundation of Cleveland. The purpose of the program is to extend knowledge of the modern process of arc welding and thereby to further its usefulness in the maintenance and operation of farm machinery and equipment. Under rules of participation that have been prepared, awards will be made for papers describing the application of arc welding in agriculture, i.e., papers that give particular attention to procedures, methods, materials, electrodes, etc., as well as economies of welding; adaptable types of welding equipment, with suggestions for new equipment and accessories, etc.

There are 131 cash awards in each of two divisions. There will be a total of $30,000 in cash awards and $7500 in scholarships for colleges of agriculture in the states in which the award winners reside. The cash awards made in each division range from $3,000 for the first award to $50. There are fifteen scholarship awards of $250 each in each division. The college of agriculture in the state in which the first award winner of each division resides will receive six scholarships totaling $1,500, and the number of these scholarships for states in which other award winners reside will be four scholarships in the case of the second award, two scholarships in the case of the third award, two scholarships in the case of the fourth award, and one scholarship in the case of the fifth award.

Recipients of the scholarships will be students of agricultural engineering or in allied scientific agricultural fields who will be selected by a committee of three in each college which shall include the dean of agriculture, the head of the agricultural engineering department (where such a department exists), and a third member to be selected by the first two.

The scholarship funds may be used by one or more students for one or more years, depending upon the number of scholarships available in the particular scholarship fund. This shall be decided by the committee designated in the preceding paragraph. The only requirement of the donor with regard to the recipients is that the scholarship awards are to be made on the basis of scholaristic attainment, imagination and promise, without regard to the financial need of the students. The winners of the awards who will be further honored as scholarships in their respective states will be designated "The John Doe (name of award winner) Scholarship of the Lincoln Foundation."

Those who may participate in the Lincoln award program are divided into two divisions: (1) Persons actively engaged in the production of food and fiber products and in breeding and producing farm animals, and (2) those engaged professionally in agricultural education or services, including teachers of agriculture, county agricultural agents, soil conservationists, and graduate students in agricultural engineering.

The jury of awards for judging these papers will be drawn from appropriate fields of agriculture and engineering, and selection of the jurors will be under the chairman of the jury of awards, Dr. E. E. Dreese, chairman of the Board of Trustees of the Lincoln Foundation.

Further details of the $37,500 Agricultural Award and Scholarship Program, which closes June 15, 1946, may be obtained by writing A. F. Davis, secretary, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Minnesota Section to Meet in June

THE next meeting of the Minnesota Section of the American this year as National Farm Safety Week, according to an- or second week in June, according to announcement of Section Chairman Arno R. Schwantes. Early announcement of the program for the meeting is expected.

National Farm Safety Week

THE week of July 22 through July 28 will be observed again this week as National Farm Safety Week, according to announcement of the National Safety Council.

The theme for this year's campaign will be the basic three-point formula for the avoidance of accidents, namely, (1) learn to recognize hazards, (2) eliminate as many hazards as possible, and (3) act so as not to be hurt by remaining hazards.

The National Safety Council is preparing various materials such as posters, stickers, and leaflets which are available to individuals and organizations that wish to participate in the Farm Safety Week program. Further information relative to such participation may be had by writing C. L. Hamilton, agricultural engineer, National Safety Council, 20 North Wacker Drive, Chicago 6.

Harvests 6,000 Acres from Arizona to Oregon with these two Self-Propelled Combines

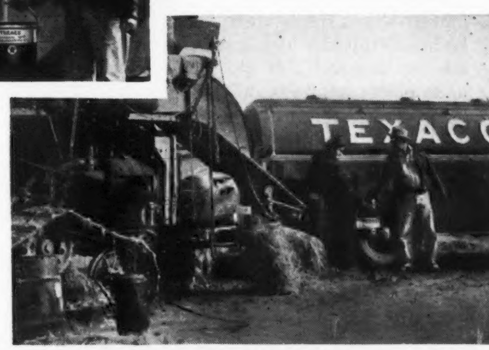
Roy Noble, Custom Operator of El Centro, California, Finds Texaco Lubricants and Fuels Best In Severe Three-State Test

TEN MONTHS' continuous harvesting, ten months' continuous traveling, from the Mexican border into Oregon and back into Arizona, a round-trip of more than 1400 miles – a grand total of 6,000 acres harvested – that's a test of machinery, fuels and lubricants that can hardly be matched on any farm or ranch in America.

Mr. Roy Noble, owner of these record-breaking combines, tried different kinds of motor oils and lubricants and reports he found Insulated Havoline Motor Oil and Texaco Marfak best of the lot, and Texaco fuels most dependable.

Mr. Noble's experience is one of the reasons why more and more farmers are changing over to Texaco Products. No one has time to gamble these days when machinery and labor are scarce.

Texaco's fine lubricants and Texaco Rustproof Compound have contributed to the life of farm machinery by reducing wear and eliminating rust, the two great enemies of farm machinery. Texaco seeks to serve well the farmers of America. THE TEXAS COMPANY



TEXACO MAN, MR. J. H. HOLLABAUGH, of El Centro, California, serviced Mr. Noble's combines in a rice field in the Imperial Valley. In the picture above, he is handing Mr. Noble a bucket of Texaco Universal Gear Lubricant "EP", for use in transmissions of tractors, trucks and cars. Mr. Noble also is shown in the inset above.

MARFAK LUBRICANT STICKS to bearing surfaces, despite jolts and jars and water wash, effectively seals out abrasive dirt.

INSULATED HAVOLINE MOTOR OIL is 100% distilled. That means it is free from carbon-forming impurities, insuring a cleaner engine, more power and pull.

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WIN THE WAR ON WEAR WITH TEXACO PRODUCTS FOR THE FARM

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The Two-Family Farm

(Continued from page 185)

to be gained would seem to justify such cooperation between neighboring but unrelated farmers.

Advantages so sought should go far beyond man power efficiency in field operations. There should be varying but roughly similar gains in man-hour efficiency in the care of flocks and herds. Reorganization of fields for conservation methods should be facilitated. Larger fields obviously will enhance the efficiency of fencing. In animal shelters and crop storages, when truly tailored to the farm enterprise, building efficiency should increase as cubage unit cost decreases with size.

It should be emphasized that these gains will not come by the mere alliance of two farms with pre-existing fields, structures, and equipment. It calls for the creation of a new farm with all its elements unified on a new scale. It calls for some new thinking as to contractural relationships and the division of labor. What is of most interest to us, it calls for a great deal of engineering in the revamping of farmsteads and the remodeling or replacement of buildings.

Return of peace is not likely to bring return of capable, dependable farm labor available in adequate amount at moderate wages. If wages were all, the challenge could be met by well-engineered farms of adequate size. Unless there be a reversal of trend, however, farming will be infiltrated with the agents and doctrines of inefficiency and mutiny which infest urban industry. Only the self-sufficient family farm can have assurance of stable operation. To achieve this and also the man-hour productivity of larger units points out a logical place for the two-family farm.

Personals of A.S.A.E. Members

Hobart Beresford, head, agricultural engineering department, University of Idaho, is one of the authors of Idaho Agricultural Experiment Station Bulletin No. 259, entitled "Potato Starch Production in Idaho," recently issued.

Harold H. Beaty and *C. H. Van Vlack,* extension agricultural engineers, Iowa State College, are joint authors of Bulletin P70, entitled "Paved Floors and Lots for Iowa Farms," recently issued by that institution. Mr. Beaty is also author of "Agricultural Engineering Plan Sheet No. 1, recently issued on "Hog House Ventilation."

Lee H. Ford, supervisor, war products service division, consumer relations department, International Harvester Co., is at present primarily engaged in work concerning the servicing of the company's war products, but when this activity is eventually discontinued, his duties will consist mainly in contacting educational institutions and cooperating on rural youth programs.

W. A. Harper, after eighteen years of service with the Caterpillar Tractor Company, was recently appointed farm sales manager for the Lubrite Division of the Socony-Vacuum Oil Company, with headquarters at 4140 Lindell Blvd., St. Louis. His territory includes the state of Tennessee and portions of Missouri, Iowa, Illinois, Indiana, and Ohio.

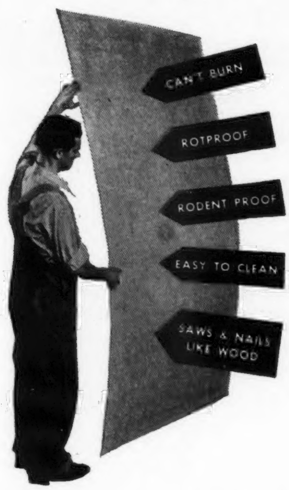
M. G. Huber has accepted the position of extension agricultural engineer at Oregon State College, effective May 1. For several years he has held a similar position at the University of Maine.

Max C. Jensen now carries the title of "civil engineer" with the Soil Conservation Service, U. S. Department of Agriculture, and is located at Caldwell, Idaho. He was previously rated as junior soil conservationist (engineering).

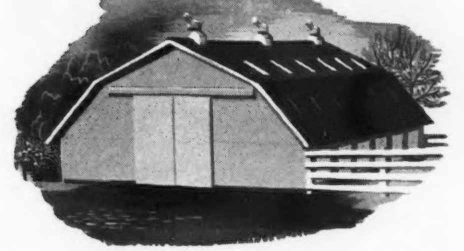
J. B. Kelley, agricultural engineer, University of Kentucky, is one of the authors of a new bulletin, Circular 403, entitled "Shed-Roof Poultry House for the Laying Flock," recently issued.

Harvey S. Looper, who has been serving as a farm manager for the Great Western Sugar Company, recently resigned to assume management of irrigated farms and livestock feeding and production operations which he owns near Lovell, Wyo. *(Cont. p. 220)*

for permanence, economy, fire safety–



specify Johns-Manville Asbestos Flexboard

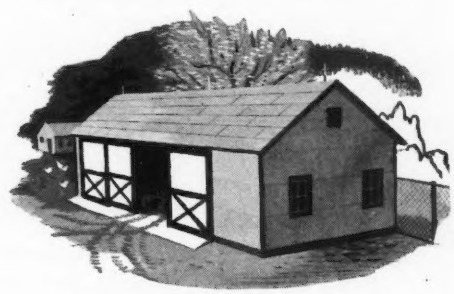


Hog Houses—Flexboard on the exterior walls makes a low-cost, weather-tight building.

Dairy Barns—Inside or out, Flexboard saves money because it needs no painting or whitewash and is easy to keep sanitary.

Quick facts about Flexboard—Made of asbestos and cement, Flexboard is hydraulically pressed and then repressed for extra strength. It has the permanence of stone, yet is inexpensive and easy to work. Comes in large 4′ x 8′ sheets. Has a hard smooth surface that's easy to clean, needs no paint or whitewash. Flexboard is fireproof, rotproof, moisture-proof, rodent-proof. Can be used inside or out for walls, roofs, floors or ceilings on new or remodeled structures.

A free research service—Johns-Manville maintains one of the most complete research laboratories in the world on Building Materials. If you have a special farm building or research problem, write to the farm division about it. J-M will gladly work with you to the extent of its facilities.



Machine Sheds—Flexboard walls and roof provide quick, low cost, yet permanent construction.

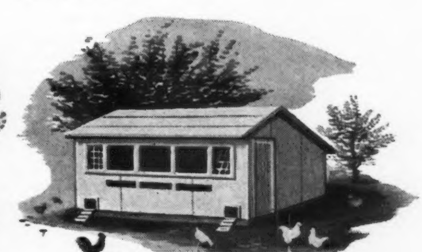
Are your files up-to-date?

Have you got the following Johns-Manville printed material?

1. Farm Idea Book
2. Agricultural Handbook
3. Maintenance & Repair Manual
4. Farm Building Plan Service
5. Low-Cost Farm Structures

Indicate the material you want and write to Johns-Manville, Department AE, 22 E. 40th St., New York 16, New York.

Milk Houses—Flexboard is easy to wash down. Helps meet the most rigid health regulations.



Laying Houses—Flexboard helps fight poultry diseases because it's easy to clean, easy to disinfect.

JM Johns-Manville

Asbestos Flexboard

Personals of A.S.A.E. Members

(Continued from page 216)

D. A. Milligan, who joined the organization of Harry Ferguson, Inc., almost two years ago as director of research, was recently given new duties and responsibilities in the company, under the title of "director of service," involving matters of expansion, coordination, and closer cooperation between field representatives, the engineering department, and the production department. His new activities cover six divisions including service claims, field complaints and solutions, product improvement information and assistance, a shop program of development, control, etc., service education, and the department of assembly of instruction books, etc.

John W. Weaver, Jr., after a few years in a privately owned poultry production business, has returned to the field of professional agricultural engineering and is now engaged as associate agricultural engineer at the North Carolina Agricultural Experiment Station, where he is giving special attention to crop processing as related to farm machinery, rural electrification, and farm structures. He was formerly on the agricultural engineering staff at Virginia Polytechnic Institute.

John H. Wessman, a first lieutenant in the Army Corps of Engineers, who entered active duty from the Reserves in February, 1942, was recently released and is now serving as an assistant editor in the consumer relations department of the International Harvester Co. at Chicago.

R. H. Wileman resigned last month as associate in agricultural engineering at the Indiana Agricultural Experiment Station, to accept the position of agricultural engineer in the research and development division of the Cooperative G.L.F. Farm Supplies, Inc., at Ithaca, N. Y. His new duties will be to conduct research and development work in cooperation with farm equipment manufacturers in developing and improving new or better farm machines. It is understood that G.L.F. has plans under way for a new research laboratory to be built in or near Ithaca.

Francis D. Yung, research engineer in rural electrification, University of Nebraska, is one of the authors of Circular 80, entitled "Electric Chick Brooding Studies," just issued by the Nebraska Agricultural Experiment Station.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

L. E. Bartlett, special representative, American Lumber and Treating Co. (Mail) 575 N. Broad St., Elizabeth 3, N. J.

D. N. Bottoms, assistant professor of agricultural education, Alabama Polytechnical Institute, Auburn, Ala.

Carl V. Carlson, project engineer, Batavia Metal Products, Inc., Batavia, Ill. (Mail) 27 N. Prairie St.

Leonard J. Erie, Capt. (navigator) AAF. (Mail) % Staging Director, Dispatch Section, Hunter Field, Ga.

Carl E. Guelle, assistant manager, tillage and seeding machine sales, International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.

C. W. Hansen, design supervision engineer, J. I. Case Co., Racine, Wis. (Mail) 246 Blaine Blvd.

Harley R. Kimmel, manager, farm equipment dept., Sears, Roebuck & Co. (Mail) 301 S. Kenilworth Ave., Elmhurst, Ill.

Charles B. Peak, Lt., administrative officer and platoon leader, H. & S. Co., 864th Engr. Avn. Bn., AUS. (Mail) R. R. No. 1, Waldo, Ohio.

Ralph Resnick, agricultural engineer, Soil Conservation Service, USDA. (Mail) 300 South Main St., Canandaigua, N. Y.

E. F. Rogers, industrial sales, Aeroquip Corp., 303 S. East Ave., Jackson, Mich.

Oliver I. Schwager, tool designer, International Harvester Co. (Mail) 1819 Lyndale Ave., S., Minneapolis 5, Minn.

Russel E. Uhland, liaison officer, Soil Conservation Service, USDA, Washington, D. C.

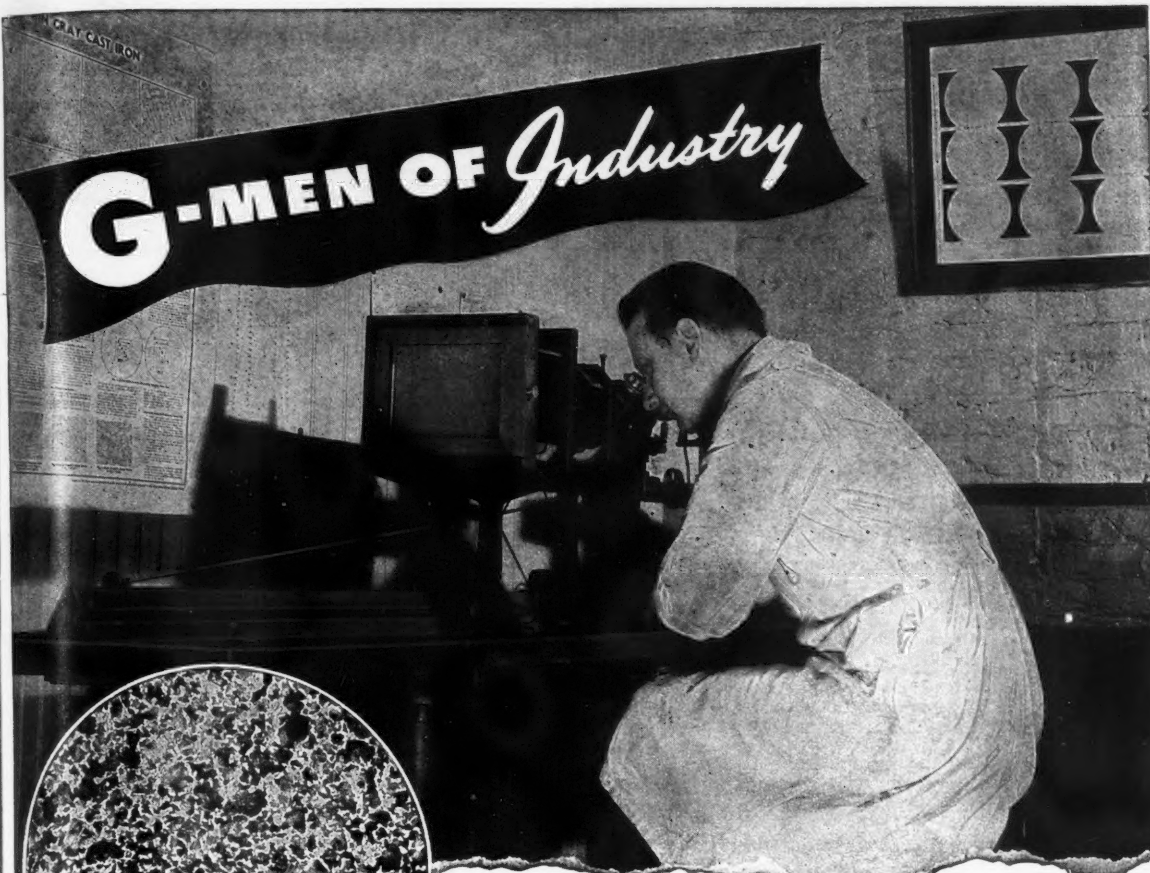
James R. Ward, specialist in agricultural engineering, University of Maryland, College Park, Md.

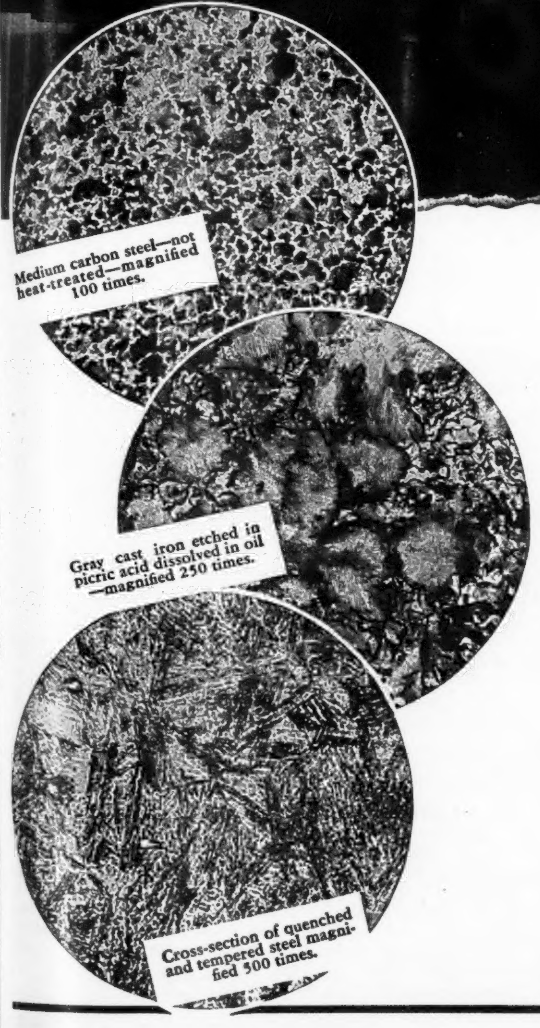
Charles H. Wilson, sales and service manager for midwest, Babson Bros. Co (Mail) 4209 Franklin Ave., Western Springs, Ill.

TRANSFER OF GRADE

Raymond T. McVeety, T/S, draftsman and computer, 671st Eng. Co. Top, AUS. (Mail) 2114 Wawatosa Ave., Wawatosa 13, Wis. (Junior Member to Member)

Lowell L. Whitaker, Lt., USNR. (Mail) Booneville, Ark. (Junior Member to Member)





Medium carbon steel—not heat-treated—magnified 100 times.

Gray cast iron etched in picric acid dissolved in oil —magnified 250 times.

Cross-section of quenched and tempered steel magnified 500 times.

LABORATORY workers at John Deere dwell in a strange land of microscopes, retorts, ovens, delicate scales, and a weird array of complicated devices. To the outsider, it is a land of mystery, but research, analysis, and testing play an important part in the manufacture of modern farm implements.

Purchasers of John Deere equipment can't see through the metal and paint—that's the function of these "G-Men" in the laboratories. It's their responsibility to insure the perfection of every nut, bolt, wheel, shaft, and working part. They are the scientific watchmen of John Deere's long-cherished reputation for dependable, economical, efficient farm equipment.

Of first importance, however, is the policy that determines the standards of perfection set for the laboratory as well as production. That policy, at John Deere, originated with the founder more than a century ago. There has been no change in that policy—there will be none. It is to turn out no piece of farm machinery or implement of which the maker might not be justly proud.

JOHN DEERE

Moline, Illinois

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any Notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

DRAFTSMAN wanted. Mechanical or structural experience desired. Excellent opportunity for one who can show ability as a designer in the farm equipment and farm structures field. PO-184

AGRICULTURAL ENGINEER wanted by large muck land operator to improve and develop farm machinery for large operations. Good permanent setup for a practical engineer. PO-183

AGRICULTURAL SALES ENGINEER wanted. Applicants will please state age, educational background, practical experience, and send photograph. Also state earnings expected and whether or not presently employed and with whom. A good job for the right party with opportunity for advancement with a fast-growing organization. PO-182

ENGINEERING ACCOUNTANT required by an American firm for Venezuela, who can speak and write Spanish. Experience in earth-moving or grading desirable. Duties include simple construction costs and office management. Position permanent. Norman DeWind, 949 Shoreham Building, Washington, D. C.

ASSISTANT AGRICULTURAL ENGINEER wanted for research in farm structures, equipment, and utilities. Equal division between college of agriculture and agricultural experiment station, including cooperative projects with industry and public utilities. Salary depends upon qualifications and experience. Give full particulars, including military status with application. University of Idaho. PO-181

ASSISTANT AGRICULTURAL ENGINEER wanted for research in hydraulics, irrigation, soil and water conservation. Equal division between college of agriculture and the agricultural experiment station, including cooperative projects with Soil Conservation Service. Salary depends upon qualifications and experience. Give full particulars including military status with applications. University of Idaho. PO-180

DRAFTSMEN wanted. Farm tillage tool experience desired but not essential—otherwise one that can apply himself in this branch of design and development. Location near Chicago, Ill. A real opportunity for a man with vision. PO-179

ASSISTANT EXTENSION AGRICULTURAL ENGINEER wanted by Arkansas Agricultural Extension Service. The phase of work to be handled and the salary will depend primarily upon the training and experience of the applicant. Give brief explanation of training and experience in first letter. Write direct to L. A. Dhonau, State Agent, 524 Post Office Building, Little Rock, Ark.

AGRICULTURAL ENGINEERS, preferably men with some experience in farm equipment, are wanted by a nationally known manufacturer. Experience desired includes design, engineering applications, market research and merchandising. Excellent opportunity for men possessing either limited or broad experience. Salary open. Replies received on a confidential basis. Education, experience and special qualifications should be stated fairly complete in the first letter. PO-178

FARM IMPLEMENT ENGINEER AND DRAFTSMAN wanted to develop garden tractors, vegetable seeders, multiple-row cultivators, and hand and horse tools for home gardens and small growers. Position permanent. No postwar conversion. State education, experience, draft status, and salary expected. PO-177

AGRICULTURAL ENGINEER wanted. Practical man with sales experience to join large steel company entering farm building field. Dealer sales development program needs men between 28 and 42 with agricultural engineering background and proven sales record in farm equipment, building or similar fields. Excellent opportunity to get in on ground floor of promising postwar industry. Salary. In reply, give complete history of education and business experience as well as references and a small photo. All replies will be held confidential. PO-176

PROFESSIONAL DIRECTORY

RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

EMPLOYMENT BULLETIN

(Continued from page 222)

AGRICULTURAL ENGINEER wanted by the Allahabad Agricultural Institute, Allahabad, India, for teaching position. Minimum qualifications, degree in agricultural engineering and some farm experience. Postgraduate degree desirable. Duties would be primarily teaching, but some opportunity to participate in research and extension. Candidate must be active Christian interested in mission work. Discharged veteran with slight handicap eligible, if in good health otherwise. Applicants may correspond with Allahabad Agricultural Institute, 156 Fifth Ave., New York 10, N. Y.

DISTRICT MANAGER wanted for western New York. Experience in the sale of dairy farm equipment helpful, but not essential. Must have automobile. Postwar future. Salary, expense allowance, commission, and bonus. Thorough field training, during which salary and expenses are paid. Write in detail, stating age, education, experience, and at least three character references. PO-175

RESEARCH ENGINEER wanted for work in farm structures and rural electrification in a land-grant college in a north central state. A young man is preferred. Salary will depend upon qualifications. Write giving full details of education, experience, draft status, and other particulars. PO-174

FACTORY MANAGER with agricultural engineering background wanted to take charge of a small factory producing barn equipment and hay tools. A permanent position for a man with executive ability and one who is interested in research and development. In first letter give full details as to education, experience, family status, age, etc. PO-173

SALES ENGINEER wanted for permanent position with small company producing well-accepted building material products. Substantial base salary, better than average proposition for man with liking for sales work and knowledge of building construction. Give full information on past experience and earnings expected. PO-166

AGRICULTURAL ENGINEER wanted by a well-known national organization to engage in sales promotion work on farm buildings, preferably someone in his early thirties with good engineering training and farm background and with plenty of initiative and ingenuity. Special training in farm buildings would be helpful to person selected. Discharged service men will receive special consideration. Write giving full details as to education, experience, etc. PO-164

POSITIONS WANTED

AGRICULTURAL ENGINEER, graduate of Cornell University with 5 years' experience in college teaching, research and extension; 1 year in research and advertising; 12 years in retail building material sales and service; 3 years scheduling and expediting for WFA, desires position with firm having production, sales or service problems in New York, Pennsylvania, Maryland, or Virginia. PW-370

AGRICULTURAL ENGINEER with B. S. degree in agricultural engineering from Pennsylvania State College desires position on a farm. Experience in repairing farm machinery and capable of making improvements in machines. Two years' experience in teaching agricultural engineering at a university, and two years in managing a cooperative business. Age 27. Married, with two children. PW-369

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